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Embossing Press.

We illustrate on this page a new embossing press which has recently been brought out by the Ferracute Machine Co., of Bridgeton, N. J. The machine is built in six sizes—two smaller and three larger than the one shown, and ranging in weight from 1,000 pounds to 13,000 pounds.

It will be noticed that the frame of the machine with its legs is cast in a single piece, the sides being formed of straight columns joined together at the top above the shaft. By this construction it is evident that great rigidity and strength are secured—attributes which are of the greatest importance in an embossing press.

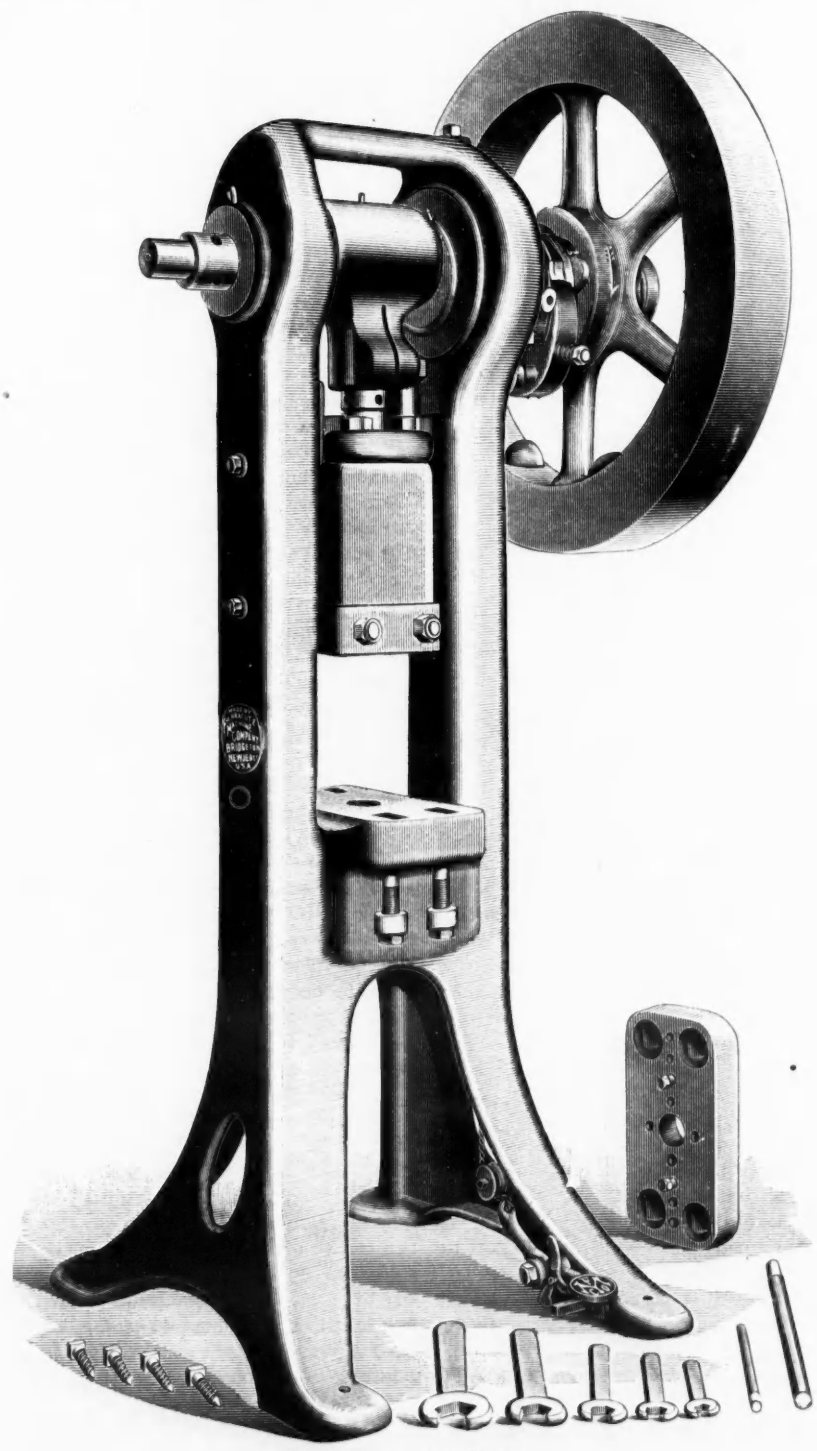
There is an unusually heavy ram arranged with very long and wide bearings, an extra long pitman adjustment, proper arrangements for clamping various kinds of punches, a positive knockout when desired, etc. The bolster can be made to order with various sizes of central hole, and is provided with die clamps, adjustable in T-slots upon the top face.

The shaft is of forged steel with unusually long journals. In an enlargement of its solid metal is mounted an automatic stop clutch of the utmost simplicity, and which has its different members so interlocked with each other in the process of assembling as to require no nuts or screws whatever—these being objectionable in a device of this kind where the tendency is to knock them loose. This clutch is provided with a safety lock which, while performing other functions incidentally, can be so manipulated as to prevent the press from starting while dies are being set, etc. A new and valuable feature consists of a so called "clutch plate," carrying the tripping device, which is adjustable around the shaft's axis, thus allowing the clutch to be tripped either earlier or later than the normal, to accommodate itself to varying degrees of momentum in the shaft and parts attached thereto, this momentum being dependent upon the conditions of speed, lubrication, extra weights upon shaft (as cams, gears, pulleys, etc.), and other circumstances which usually have to be controlled entirely by a brake, thus in many cases losing a large amount of power. In the hub of the fly wheel, besides four hardened steel studs for driving, there are also mounted self-acting locking pins, which while allowing the clutch slide in shaft ample time to enter spaces between wheel-studs, finally lock the same after entering and thus prevent the annoying backlash incident to the use of spring-drawing dies and elastic work of various kinds.

The clutch is the same as used with the machine illustrated in our issue of October 5 where an engraving showing the clutch in detail was presented.

In general, this machine is characterized by carefully proportioned parts, great weight and inertia to those submitted to heavy stresses, harmonious curves, heavily rounded corners, absence of external ribs, case hardened bolts and nuts of large diameters, etc.

The weight of this press is about 2,800 pounds, and the dimensions, etc., are as follows: Hole through bed, 3″ round (or enlargeable to order up to 6″ square); clear width between columns, 11″; height of bed to ram with ram up, 10″; stroke of ram, 2″; adjustment of ram, 3″; diameter of fly-wheel, 36″; width of same, 5″; weight of same, 725 pounds; speed of same, 100 revolutions per minute; thickness of bolster plate, 2½″; pressure safely exerted by ram about 38 tons. Each column has a 3″x7″ cross-section.



NEW EMBOSSING PRESS.

It is stated that the largest cross section that can be shipped over principal English railways is 12x9 feet, so that this is the practical limit beyond which the parts of machinery to be shipped by rail must not go. This also practically limits the capacity of machine tools such as planers and boring-mills for general use where the work turned out must be liable to shipment by rail though there are larger tools in special locations where this limit does not apply.

Progress in the Science of Melting and Cupola Construction.*

NEW CENTER BLAST TUYERE AND ITS ECONOMICAL ADVANTAGES.

BY THOS. D. WEST.

It is a question if in any of the industrial arts there has been so little improvement in the last forty years as in the cupola used for melting cast-iron. It is not owing to the lack of effort toward improvement, for we find that there has been untiring energy and much capital expended in experimenting with different forms and principles in cupola construction, to reduce the ratio of fuel to iron, or, practically speaking, to reduce the cost of melting. To-day it is a point open for dispute if a better understanding of the science of "running a cupola" has not as much to do with its economical operation as any improvements in the construction of cupolas.

I think it will be admitted that little or no radical advance had been made in management until the advent of practical writings upon the melting of iron. As the chief pioneer in this we should all bow with respect to Dr. Edward Kirk, author of "Founding of Metals," a work published in 1877. Without a positive change in the principles of melting and construction of cupolas now in use, I do not see how it will be possible to make any greater advance in the matter of economy, which now means, according to the conditions of requirement, the use of one pound of fuel to melt from five to ten pounds of iron. I think it is now thoroughly understood what is true economy in the use of fuel, and why the same intelligent melter might be required to use one to five in one case, where one to ten would answer in another.

With our present methods, one field now presenting itself for the acquisition of knowledge in matters of melting and cast-iron is in the chemical action taking place in the remelting of iron. I have been greatly interested in the papers and discussions emanating from this organization upon the question of chemistry, and think the subject of the utmost importance to many foundries. There are those that can get along without having chemical service, but they are very few who could not obtain practical benefit from a use of the knowledge now obtainable upon the question. I know that in the ingot department of our foundry we could not afford to abandon chemistry. Not only do we know the chemical qualities of every charge of iron that goes into our cupola, but also that of the coke. When running full our heats range from fifty to seventy tons per day, and the product is analyzed and a record kept, so that we are enabled to ascertain if anything is going wrong and chemically compute what goes in and what comes out of the cupola.

The adoption of chemistry in our foundry was not a question of choice. We were compelled, from self-defense, to know what our product contained, as we found our customers often attributing short service in particular molds to excessive silicon or sulphur, when it was plainly not due to these causes. To protect ourselves against claims of this nature, as well as to insure uniform analyses, we found it necessary to know not only the analysis of our pig-iron, but also of our product. Comparison of analysis with service naturally followed, which in time resulted in a somewhat elaborate system of records. It might be advisable to state here that in our practice we use all pig-iron, and that such practice gives an advantage for obtaining reliable data that foundries purchasing scrap to mix with pig metal could not secure as readily. Generally speaking, purchased scrap iron is a miscellaneous collection of everything, and to attempt to know its chemical composition would generally involve so much labor and expense as to make it impracticable. With some scrap piles, by taking several samples and mixing their drillings, so as to obtain an average, an analysis might often work very fairly; but such a case would be the exception to

* Read at the Meeting of the Western Foundrymen's Association at Chicago.

the rule. It would be best in such cases when special results are desired, to abandon the use of scrap and use all pig-iron.

The president of our company, Mr. Geo. H. Boyd, has formulated quite an elaborate system for recording the chemical and physical qualities of our iron and product coming from it. The way the subject is classified enables us to obtain some very valuable data. As an illustration we will take up the question of silicon and sulphur. Here we find, by remelting or by the action of the fuel and blast in the cupola, that we reduce the silicon from one tenth of one per cent. to four tenths of one per cent, but this reduction is generally uniform. We think it is only through some radical change in manipulating the blast to the cupola it is caused to be reduced below two-tenths of one per cent. On the other hand, we will increase the sulphur one time two-tenths of one per cent., and perhaps the next five-tenths of one per cent., when using coke of same analysis and in uniform ratio to iron charged. The manipulation of the cupola alone seems to affect the sulphur to a greater degree than the silicon, for the silicon is generally reduced uniformly, while the sulphur seems to have no regularity about its increase; and I am inclined to think the varying temperature existing at time of melting is the main cause of the irregularity found in the sulphur when same coke is being used. The Connellsville coke we use will average 0.80 in sulphur; the iron 1.50 silicon, .040 sulphur, manganese 0.34, phosphorus .092. The analyses of the above materials are given so as to enable any one that might be inclined to do so to take the matter up and compare notes with us.

There is a large field for investigation in chemical matters for the founder to explore, and the information to be obtained will enlighten us upon many mysteries we now find ourselves at a loss to fathom. I do not wish it understood that we are relying wholly upon the chemical analysis of iron, for there is too much to be discovered in that line ere we can ignore the physical qualities of iron in judging of and attaining results. While cupola work is progressing in respect to chemistry, I think from my late efforts and results there will be further achievements in melting, barring what might come from the little explored region of electricity.

Before entering upon a description of my late experiments, I think a brief recital of different plans and principles that have been tried in various cupolas for the past 50 years would prove very beneficial in leading up to a ready understanding of the advantages the writer desires to set forth in illustrating the new principles which he has originated in experimenting with melting by means of what we will term a center blast.

An investigation of the experiments made in cupolas with a view to economy in fuel shows there have been many failures and we find almost all plans imaginable have been tried. Europe far surpasses this country in originality and novelty of designs, but I question if America has not excelled in the points of good general utility. The first radical beneficial step we find to have been taken is in the adoption of the "drop bottom," an American invention. Ere this came in use, bottoms were composed of solid masonry or fire-proof material from the ground up to the spout, and in order to get the "dump"or refuse out of the cupola after a heat was finished the "front breast," being made large, would be knocked out, and by means of pokers the refuse and cleanings would be raked out. I am led to believe that this plan is still being used in some parts of Europe to-day. From the adoption of the "drop bottom," improvements have been mainly in the line of securing greater economy in the use of fuel. The most radical divergence from the common cupola has been caused by experiments in designs arranged as in the Woodward cupola, in which it was sought to create a blast economically by means of a steam jet blowing up the stack; also as in the Rirger cupola, which instead of forcing the blast upwards reversed the order; then, again, as n cupolas arranged to utilize gas for a fuel.

In examining some of the cupolas that have been tried one would surely think that if crooks and oddity had any virtue, perfect combustion would have been accomplished long ago. This may be secured, but we find more founders have faith in the common cupola. My definition of common cupola is one of plain cylindrical form having one or more rows of tuyeres. The question of inside formation and illogical shapes given to cupolas has about run its course of absurdity and this has been helped by late literature upon melting. We are rapidly advancing in understanding the principles and science involved in the proper construction of cupolas and melting, and to-day we find the only element of any value that has been grasped from out the chaos of ruined expectations in the construction of cupolas is that of economical combustion being attained by two or more rows of tuyeres. In order that all may be able to follow this paper intelligently and understand the philosophy and advantages to be gained by "upper tuyeres" we will first note the action of fuels in order to obtain perfect combustion. "According to Dulong

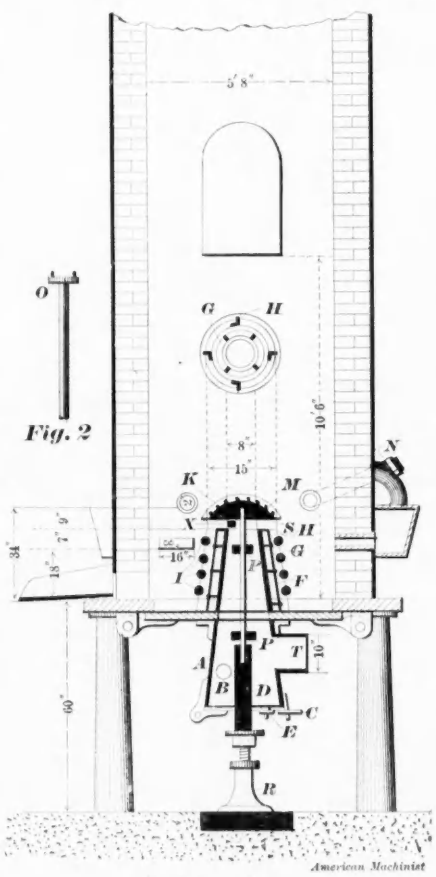


Fig. 2

Fig. 1.

WEST'S CENTRAL BLAST TUYERE.

one pound of carbon combining with the necessary quantity of oxygen to form carbonic acid develops 12,906 units of heat. The specific heat of cast-iron being about 13, the melting point 2,190 degrees, and the coke containing 82 per cent. of carbon, then to heat a ton of cast-iron of a temperature of say 40 degrees to a temperature of 2,190 degrees, would require $\frac{2{,}150 \times 2{,}240 \times .13}{12{,}900 \times .82} = 59.1$ pounds coke. This is supposing that the whole of the carbon is converted into carbonic acid, but if by any means carbonic oxide is formed a very different result is obtained; then one pound of carbon to carbon oxide evolves only 4,453 units of heat. If, however, by admitting air above the zone where the oxide is formed we recover 4,478 units, this with 4 453 gives 8,931, which is a little over two-thirds of the available heat to be gotten out of one pound of carbon, allowing ten per cent. for moisture in the coke, ten per cent. for radiation and 20 per cent. for loss of heat passing off at the top of the cupola, or 40 per cent. in all. The amount of coke per ton of metal should not exceed 112 pounds although the actual consumption is, as we have shown, usually much higher."

The combination of carbon with oxygen or air blown through the "lower tuyeres" produces carbonic acid gas in the bottom bed of fuel and this in passing up through fuel heated to incandescence takes up more carbon and is converted into carbonic oxide gas. Now if the carbonic oxide can again have sufficient oxygen or air admitted to it we will again have carbonic acid or more nearly complete combustion, and by such alternate zones which at every repetition become less volient, we could if it were only practical to hit the right spot of the descending stock with the proper amount of air, almost achieve the theoretical figure of melting one ton of iron with 59 pounds of fuel as given in above figures; but instead of that we consider if we can accomplish this with 200 pounds of fuel we are doing exceptionally good work.

We have cupolas figured to achieve the above results by combination in tuyeres and in reality cupolas having two or more rows of tuyeres can be the only ones properly entitled to the claim of being scientifically constructed as far as the admittance of blast is concerned. Were it only possible for the blast passing through the tuyeres to penetrate to the center of the cupola and have an immovable zone of fuel to play into, it might successfully accomplish the end intended, but as it is the results are but partial, it is a question if the extra burning out of the lining which two or more rows of tuyeres cause by having more melting zones does not often more than compensate for what saving in fuel may be secured.

The economy that is possible if two or more rows of tuyeres could only be made to force the blast to the center of the cupola and at the right elevation, caused me two or three years ago to give thought to the subject and to desire to get nearer the theoretical figure than present cupolas were doing if it could be possible.

One plan after another suggested itself until the idea of a center blast came to me. Having two cupolas in our shop, I thought I would experiment with the smaller, which is 40 inches inside diameter. Cutting a round nine inch hole in the "drop doors" we attached to the underside when the doors were propped up an eight-inch blast pipe. Inside the cupola and resting on the "drop doors" was placed a cylinder ten inches diameter by eighteen inches in height, on the outside of which were prickers protruding about one and one-half inches so as to support a lining of clay. On top of this cylinder was placed a clay cap supported by three pieces of fire brick so as to leave an opening two and a half inches high for the admittance of the blast. The outside tuyeres were all stopped up and all the blast admitted to the cupola up through this center cylinder tuyere. The first heat was carried through with the same fuel as used with the old system of outside tuyeres and resulted in giving hotter iron melted in about the same time. Several more heats were run off reducing the fuel each time and still giving iron hotter than with the old system. The most astonishing feature of the experiments was the little or no burning out of the cupola lining. In fact the process seemed to cause a glazing effect that was beneficial to the lining.

The experiment in this small cupola resulted so favorably that we concluded to try the plan in our large cupola in connection with the outside tuyeres, which we did after the plan illustrated by the cut herein shown. Before starting in to use this bottom center blast tuyere we were not safe in trying to do better than one to seven or eight in fuel, as our metal came all from pig-iron and had to "come down hot." With the combination of the center blast and outside tuyeres we found we could obtain hot metal with one to ten or eleven, and I would state that the one to ten and eleven iron was often much hotter than the one to seven or eight melted with the old process, and it would often come so hot it would take considerable scrap to cool it off before it would be wise to pour the metal. To say it would be as hot as stove molders would often care to use it, would probably be the best way to convey an idea of its heat, and it might be well to state that the metal would be hotter at the end than at the beginning of the heat. The cupola men liked to use the device, as it made the work of chipping out and daubing up the cupola so much easier than in the old system, for in fact there would often be very little of such work to do. In my experimenting there were several plans tried, but the one recommended later on is the best and last one I am using with this system. It cannot but be evident that with such a plan the blast is conveyed to the center of the cupola or body of fuel, where it should be to achieve the greatest results, and if the theoretical point in perfect combustion is ever to be reached it will be by some such system. Not only does this plan save fuel, but also the lining of cupolas, while the present methods or principles now used for accomplishing economy in fuel do so at a sacrifice to the lining; so much so as to make it in many cases a question if there is any economy in using "upper tuyeres."

I know there are those that will wish to criticise the plan here presented, and say that had we used "upper tuyeres" we would have accomplished the economy in fuel which we did with our new system. To all such I would say that by looking at the cut at *N* herein shown they can see that such was used, for the cupola as now shown is, as far as outside tuyeres are concerned, used the same as when we could not do better than one to seven or eight. I know we read about melting one to ten or eleven, and up as high as sixteen. I only wish to say that by the adoption of the plan here presented they should do still better, and not have what they save in fuel lost by cutting out the lining. No doubt many can from a glance at the drawing conceive at once the whole scheme of the plan, but I think almost all would prefer a detailed description of the working of the system. *A* is an outside tuyere box made of one-quarter-inch wrought boiler plate, so as to make it light for dropping purpose. It is bolted only to one-half or section of the "drop doors." *B* is a peep-hole, arranged with isinglass, for the purpose of seeing if all is working well. *C* is a hinged cover having a hole for the bar cap supporter *D*. At *E* is a one and one-quarter-inch hole stopped by a little pivot swinging valve, so that if through the peep-hole *B* any leakage should be seen this valve could be swung back to let the metal or refuse run out. It will be noticed that the tuyere box *A* is made of a taper, so that should slag iron or refuse drop down into it, it could be readily relieved. The cylinder at *F* is made of an inner and outer ring of one-quarter-inch boiler plate. The space *G* is filled with fire-clay. *H* shows angle iron, of which there are four pieces, for the purpose of supporting the round iron rings *I*. These and the angle irons are for holding and preventing the bagging of the fire-clay, which is daubed on over them to protect the cylinder *F* from the melting heat of the cupola. This clay would be put on after the cylinder is placed in position inside of the cupola, and dried by the burning up of the bed. It would be the better plan to have two cylinders, so as to have one all the time on hand for drying in an oven. One heat gave us trouble through lack of care when half through by the metal getting through the clay to the iron rings. *K* is a clay cap having a cast-iron prickered casting, as shown at *M*. The clay or ganister used for forming this cap *K* and daubing over the cylinder *F* should be of the best quality. The one and one-half-inch bar shown at *D* is in two sections, so as to enable its being pulled out before "dropping the bottom."

In cases where cupolas stand high the bar might often be worked in one piece. In placing the cap *K* on the cylinder my first plan was to let it rest down upon it, and then after the blast was on and the iron commenced to melt, the jack-screw *R* would be raised, thereby lifting, of course, the bar *H* and the cap *K* to make any width of opening at *S* for the admittance of the blast that would be thought wise. The raising of this cap up against the pressure of coke and iron gave us trouble at one heat through breaking off of the clay at the outer rim of the cap, so that after the cast was about two-thirds over the heat in the cupola had

melted the casting *M* so as to cause a leakage down into the tuyere. We then tried another plan by letting the cap rest on three pieces of fire brick, one of which is seen at *X*, as done in the 40-inch cupola; these being equally divided, the blast would have ample room to find space for entrance between the top of the cylinder *F*, and the cap *K*, as at *S*. In order to prevent the blast from entering this tuyere before the iron commenced melting, we used a damper as seen at Fig. 2, which should be placed up in the cylinder *F* at a point about level with *H*, and which consisted of a jointed bar the same as seen at *D*, having at its end a round piece of one half inch boiler plate, as at *O*, having prickers riveted into it for the purpose of holding clay to keep the damper from getting hot, and also bring the clay down when the damper would be removed, or the blast allowed to enter the cupola. This arrangement, of course, did not require any jack-screwing. We simply had the bar *D* protrude below the tuyere box cover *G* about two inches, so that a swinging catch attached to this cover supported the rod *D*, and in removing this damper we simply knocked the catch away, and the damper fell down, bringing its clay with it. Of course, with arrangement of damper, the center supports or guides *P P* for the bar *D*, when the raising plan was used, were removed. This plan was a decided improvement over raising the cap, and worked all right. The reason for it not being desirable to admit the blast through the center tuyere before the iron commenced to melt was, in the first place, to have the bottom outside tuyeres get the carbonic acid gas well started from the lower fuel before admitting oxygen to combine with the carbon oxide created in the fuel above the bottom tuyeres, upon the same principle that it is desirable to do so with upper outside tuyeres. In the second place it greatly aids in preventing the tuyere hanging up when the bottom is dropped, with large heats.

The cap *K*, as shown, was made larger than the cylinder *F*, so as to prevent the dropping metal from falling or getting into the opening at *S* during the heat. It will be noticed that the point of entrance for blast at *S* is higher than the bottom outside tuyeres. This is done to achieve the end accomplished by upper outside tuyeres in admitting oxygen to combine with the carbonic oxide in turning it to carbonic acid gas, thereby making more complete combustion.

In making connections for the blast with the center tuyere box *A*, conditions will vary the plan to be adopted. The attachable pipe coming to this tuyere and connected at *T* should be an independent one coming directly from the main blast pipe, and not from any of the side tuyeres or wind boxes, and a damper should be arranged in this main side branch pipe so that the pressure of the center blast can be regulated independently of the outside blast. The cupola shown has twelve outside tuyeres, six of them being lower tuyeres 3″x16″, and six of them upper tuyeres two inches in diameter. The width of opening for the center blast admission of air was about 2½ inches. In "dropping the bottom" after heavy heats we sometimes found that the center tuyere would hang up, but by a little rapping on its protruding end with bars it would come down, and leave a good "dump" or "bottom dropped cupola." In using this tuyere by itself or in combination with outside tuyeres it is essential in large heats to flux a cupola well and run the slag off. By letting slag remain in the cupola it readily chills around the tuyeres and thereby causes "bunging" or "hanging up," and it might be well also to state that the outside tuyeres should be kept well open so that the blast can find easy delivery to the end of the heat through them. At the start the blast should not pass through the center tuyere with any more force than necessary to counterbalance the inside wind pressure.

If this system should be adopted in cupolas that are to run steadily over ten hours, like those at steel works, I would like to hear of some one trying the cylinder *F* (instead of as here shown), having it constructed of all fire-brick, every other course being tied with a thin plate of boiler or cast-iron, the edges standing back, so as to be protected by a covering of clay. These rings should not be over ⅛″ thickness. The idea is to make sure of the heat not causing any cracks to occur in the brick tuyere or burn the edges of the rings while the blast is on. By well tying the brick work or breaking its courses it might stand well without the use of the iron rings. I have tried an all fire-clay cylinder tile baked in a fire-brick kiln, but it did not prove a success, as it was cracked and gave us trouble from leakage. For ordinary cupola work, I know that with care and judgment the plan here illustrated, and having the two cylinders as above suggested, could be made to work successfully, and all who try it will find they can save fuel and the cutting of their lining. The latter with some firms is a very costly affair. Of course, in starting in to try this system one is not expected at the very first heat to charge with a radical change in using less fuel, but gradually trying less every heat until they find by trial just how low they can get. At the start you can at least depend on reducing the bed in bulk whatever the bulk of your center tuyere may occupy, and between charges have 20 per cent. less fuel. I know that in our 68 inch cupola we reduced the bed after trials from 3,000 to 2,100 pounds, and in charges from 900 down to 500. The iron we place on the bed is 8,000 pounds, and between charges 6,000 pounds, and, as stated in first part of paper, our heats run from 50 to 70 tons. We are still experimenting in this line, but as business has been so dull for the last three months, there has been but little opportunity to go ahead and compute the results.

A remarkable coincidence in this experimenting is that after I had been laboring with the new system, thinking the idea was alone with myself, a letter came from the far North showing that another foundryman was likewise experimenting—Mr. Thomas H. Widdowson, of Mankato, Minn., who wrote me on this subject after I had been at work upwards of a year. I have mailed Mr. Widdowson a notice of the reading of this paper and invited him to be present to discuss the merits of our respective operations.

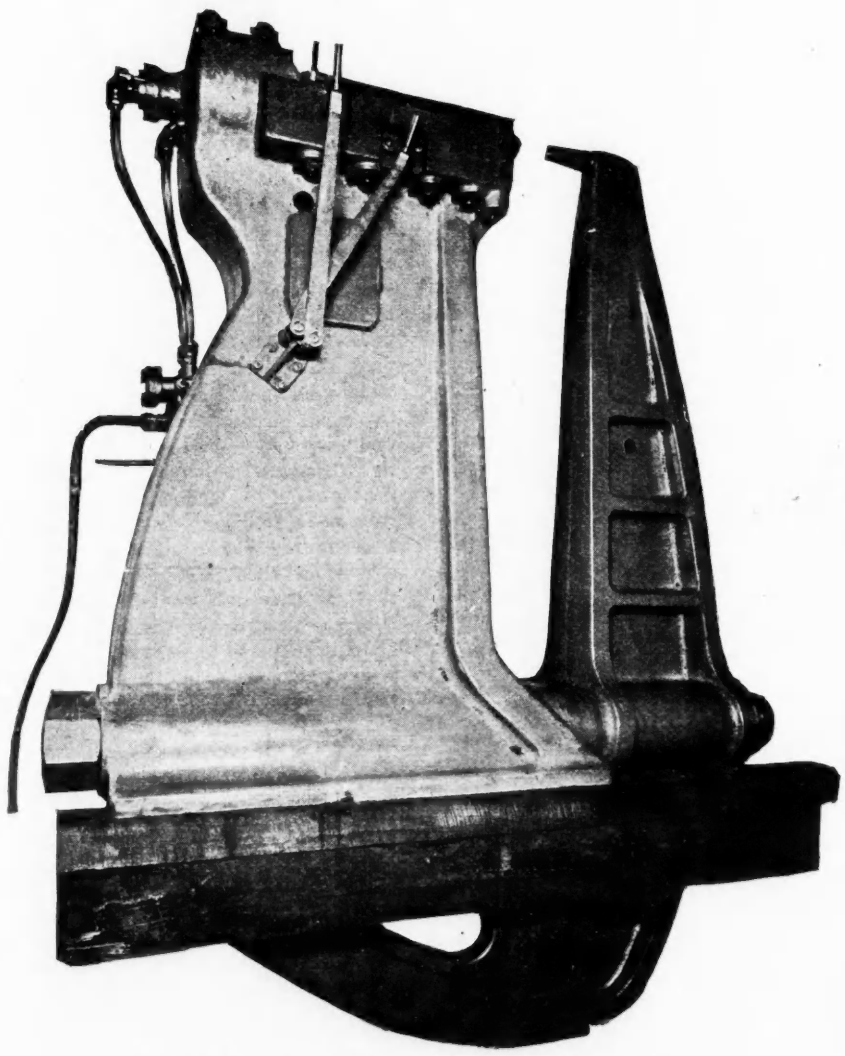


Fig. 91.—PLATE CLOSING HYDRAULIC RIVETER.

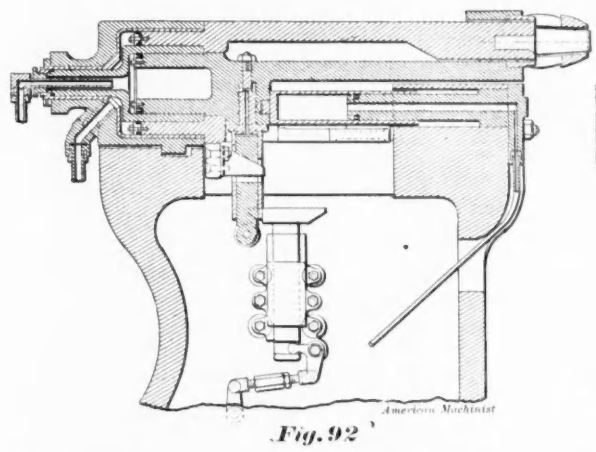


Fig. 92.

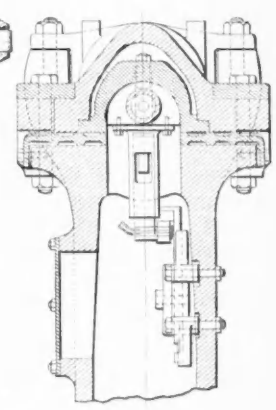


Fig. 93.

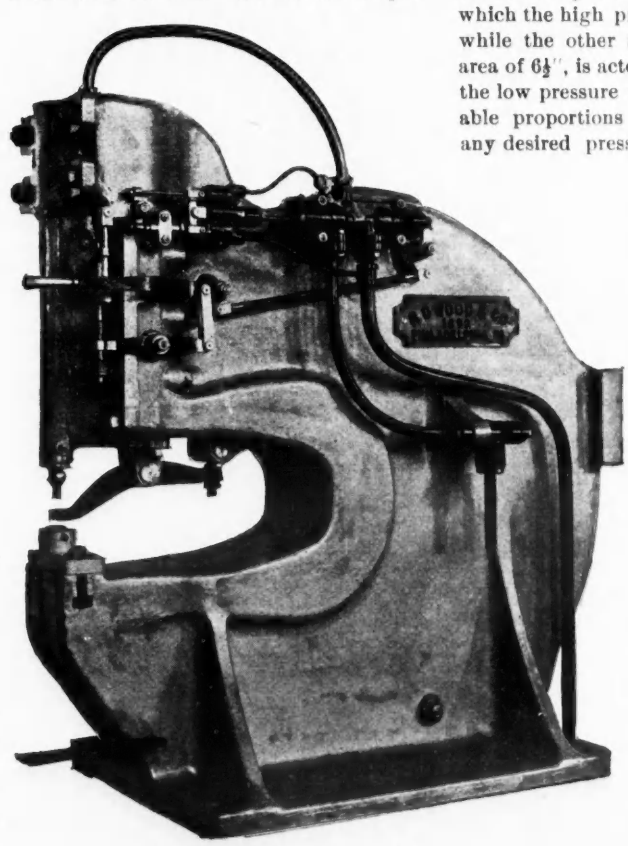


Fig. 94.—HYDRAULIC RIVETER.

Columbian Exposition Notes—XVII.

Editorial Correspondence.

Though the exhibit of R. D. Wood & Co. (Philadelphia) includes much that cannot be classed with tools, it also contains several specimens of hydraulic tools possessing features of considerable interest. In connection with these tools, which are shown in operation, is what is called

AN INTENSIFIER,

which seems to be simply a duplex, single-acting hydraulic pump. Its object, as its name indicates, is to supply water at a higher pressure from a service at a lower pressure, the higher pressure to be used in working hydraulic tools or other machinery. In this instance the machine consists of two 6½″ cylinders, which are placed horizontally side by side upon the frame. There is in each of these a hemp-packed piston, which is connected to a piston rod 5″ diameter, this being also packed with hemp. This leaves an annular space ¾″ wide at one side of the piston, this being the side from which the high pressure water is delivered, while the other side of the piston, the full area of 6½″, is acted upon by the water from the low pressure service, and thus by suitable proportions of areas, water at almost any desired pressure can be obtained, the proportion in this instance being about 13.5 to 33. The valves are worked upon the duplex principle, and the pistons alternate in movement, thus producing a steady and smooth action. An accumulator is used for maintaining this pressure.

Several forms of hydraulic riveting machines are shown, prominent among these being that illustrated in Fig. 91, which is a "plate-closing riveter," with eight-foot gap, and capable of exerting a pressure of 70 tons. It is fitted with automatic release mechanism, which at the proper point releases the pressure from the plate, and transfers this pressure to the rivet dies, where it acts in addition to the other pressure to give the final set to the rivet. This transfer can be made to take place at any point up to that at which the rivet set is within ⅛″ of the plate, and, acting automatically, it insures that full pressure shall be put upon the rivet at the predetermined stage. Figs. 92 and 93 are vertical, longitudinal, and cross-sections of this machine, showing the arrangement of slides, rams, etc.

It will be noticed that the main slide, which is a steel casting, is so formed as to be narrow at top, and thus give an unobstructed view of the work. The main

cylinder is also a steel casting, lined with brass, and inside this is a brass bush, which forms the cylinder for the plate closing slide. By removing the automatic stop pieces, the main slide can be pushed forward so that the leathers are cleared from the cylinders, and the renewal of the packing

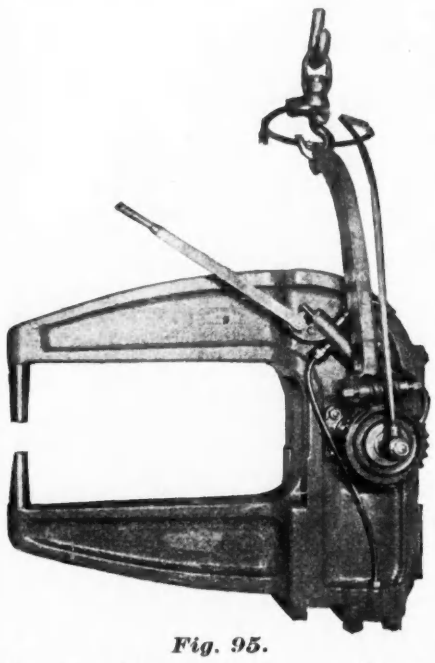


Fig. 95.

PORTABLE HYDRAULIC RIVETER, PARALLEL TYPE.

can thus be effected without removing or lifting any of the heavy parts of the machine.

At Fig. 94 is an illustration of another machine which is included in the exhibit, this being either a punch or a vertical riveter. It has a 30″ gap, and its capacity is to punch ⅞″ holes through ⅞″ steel plates, or by changing tools it will set 1¼″ rivets. Unlike geared machines, the stroke is adjustable, having in this particular machine a range of ½″ to 4″, the longer stroke being especially for upsetting rivets. The machine works either by pressing the treadle in the ordinary way, or automatically and continuously as may be desired.

In operation, as seen here, the machine seems much like a belt or engine driven tool, but there is this difference, that the movement of a small lever instantly starts the punch at full speed and power, there being no fly-wheel to be got up to speed before work can be done or to dissipate its energy by idle running when the machine is not in use. The cylinder of this machine is also a steel casting lined with brass, and it will be noticed that things are so arranged that a clear view of the work can be obtained and angle iron can be punched. As in the other machine described, the packing leather can be renewed by removing the stops, and running the ram out, and there is a special stuffing-box which prevents leakage of water upon the work. All valve mechanisms are so arranged at the side of the machine as to be easily accessible.

A hydraulic shear which is also exhibited is about the same size, but of somewhat different design, the head of the machine in this case being cylindrical in form and receiving a steel cast cylinder, lined with brass, fitted with a bayonet joint. To the ram is bolted a rectangular slide which carries the blocks for the shear blades. The valve gear also differs from that of the punch, in being operated from an auxiliary cylinder. The machine operates automatically when desired, and is shown with an attached swinging jib crane for handling the plates.

Another feature of this exhibit is represented at Fig. 95 which is a portable riveter of what is called the parallel type, *i. e.*, instead of being hinged as usual with such machines and with the cylinder back of the fulcrum this has slides at the back within which the cylinder and ram are placed. This, of course, brings the dies together in a straight line parallel with the center line of the rivet; which is thought to be advantageous on some accounts, though in machines having jaws of considerable depth, the departure from a straight line is probably not very noticeable where the ordinary hinged type is used. This machine has the further advantage, however, of requiring a cylinder no larger than if located directly over the rivet, whereas the hinged type requires one much larger, owing to the loss by leverage, the cylinder being always placed much closer than the dies to the fulcrum.

The method of suspension for the machine is such that it is very nearly balanced at all times, and its position is controlled by the aid of worm-gearing as shown. The machine exhibited has a 36″ gap and can exert a pressure of twenty tons.

Another portable riveter exhibited is illustrated at Fig. 96 and is called the "Bear type." In this machine the cylinder and ram are at the ends of the arms. The machine has a 12″ gap and 20 tons capacity. It is so suspended that it can be placed in any desired position by means of the worm-gearing shown and is under perfect control at all times.

Besides there are a number of other machines worked by water pressure, among them hinged portable riveters, traveling and jib cranes, all being designed for working at a pressure of 1,500 pounds per square inch. The whole forms an interesting exhibit of such machinery aside from the fact that it is the only one of its kind in the exhibition.

OLSEN TESTING MACHINES.

An interesting display of testing machines of various types is shown by Tinius Olsen & Co., of Philadelphia. The machines are belted up and tests are made for those interested. The exhibit includes several automatic and autographic machines in which the counterpoise is automatically

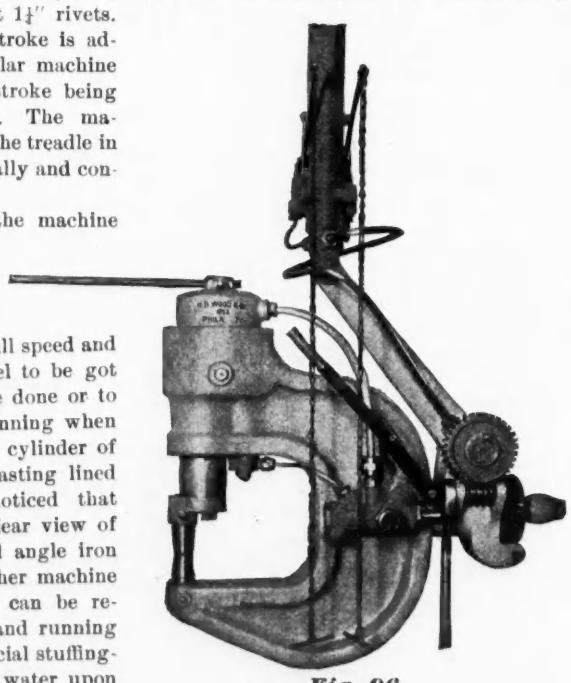


Fig. 96.

PORTABLE HYDRAULIC RIVETER.

moved out upon the beam by a screw as the strain upon the specimen increases, while this movement is at the same time recorded upon a sheet of paper wound upon a revolving drum. Also by attaching to the test specimen small cylinders partly filled with water and connecting these with a similar cylinder placed in front of the recording drum, the distortion or elongation of the specimen is shown. The shock of recoil in breaking tensile test specimens is taken by suitably arranged rubber buffers in the base of the machine. These machines were illustrated in our issues May 30, '89 and June 4, '91.

THE FANEUIL WATCH TOOL CO.

As is usually the case with exhibits of watch tools (much to the dissatisfaction of practical mechanics who like to get their hands upon machinery when trying to judge of its quality), the exhibit of the Faneuil Watch Tool Co., of Boston, is inclosed in glass show cases, where it can be seen but not otherwise sensed. The exhibit is, however, of course a very attractive one, and includes most of the regular tools employed in watch making, as well as some special ones; the most prominent single feature of the exhibit being the Rivett lathe and attachments which we illustrated and described in our issue of July 28, 1892.

AMERICAN SCREW CO.

The very latest developments in the art of wood screw making are shown by the American Screw Co., of Providence, the exhibit consisting of two machines for making wood screws by the Rogers cold forging or swaging process. Both machines are operated for those who are interested in such matters, and their operation is admirable in every respect.

The first machine is called the heading machine, though in fact it does much more than merely head the blanks, for it finishes them ready for threading, including the heading, pointing and slotting, as shown at the right of Fig. 97, which figure, taken from left to right, shows the progressive stages of the wire as it comes from the coil, passes through the straightener and is acted upon by the various dies and plungers. In this process there is absolutely no removal of stock by cutting, except in forming the point, this last being done by dies which cut and form at the same time, not in the ordinary way by rotation of blank or dies, but by shearing force, there being usually at each side of the pointed section a fin of metal crowded out by the dies, but adhering by a thin fin. This is removed by tumbling before the blanks go to the thread rolling machine. The heading machine is much like those so generally used for making rivets, except that it has means for shifting the blank and for bringing the various tools into operation upon it.

The threading machine is of the modern type, which uses two dies that are straight plain bars of steel except that they have grooves formed in the face corresponding to the threads to be formed, these grooves being at an angle corresponding to the angle of the spiral of the threads. One of these dies is then moved in a straight line past the other one, with sufficient room between them for the blank to be rolled along by the motion, and this space gradually decreases, so that the metal as the blank rolls is gradually squeezed or swaged to form the thread. Fig. 98 shows the blanks as they appear at different stages of the rolling process, although it will be understood of course that the process is continuous, and that a screw is threaded at every movement of the die; which means very rapid work. We thus have a screw that is a very good example of the modern cold swaged work, since practically no cutting whatever is done upon it. It would seem as though such punishment of the stock ought, according to all ancient

Figs. 97 and 98.

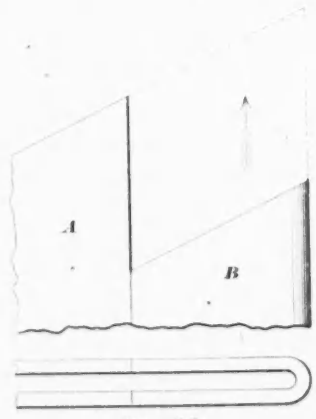


Fig. 99

principles of metal working, destroy its strength entirely, but these screws are declared to be stronger than those with cut threads, besides which they are claimed to have other advantages better understood by woodworkers than by myself.

There is an automatic blank feeder on this threading machine that I can appreciate, however, and its construction will be understood from Fig. 99. Supposing all that is shown there to be within a hopper into which the blanks are thrown promiscuously, and that the portion *B*, passing up through the bottom of the hopper, is given, by suitable mechanism, a vertical reciprocating motion, so that its upper inclined edge rises from the bottom of the hopper until it is even with the portion *A*, as indicated by the dotted lines. In passing up through the mass of blanks, some of them usually fall into the slot, shown in the plan view below, and as this slot is somewhat wider than the diameter of the blanks, but too small to admit the head, the result is that they are suspended vertically within the slot, points down, and with heads resting on top of the incline. When the part *A* rises to its full height and dwells there a moment, the blanks slide down into the part *A* and then pass to the dies, one at a time, as they are wanted. Sometimes *B* rises to position for delivery without a blank in shape to be delivered, but usually it has better luck, and the average is more than sufficient to supply the machine.

F. J. M.

Something About Packing.

BY W. H. WAKEMAN.

If a manufacturer or steam user who orders a new engine does not specify that the piston rods shall be packed with metallic packing, he makes a mistake, for they will last enough longer to pay the additional cost several times over, and in addition to this the saving in the cost of fibrous packing will be enough to prove the cost of metallic packing to be a good investment. Especially is this true with the high steam pressures that are so rapidly coming into use, but inasmuch as some new engines are being erected without the improved packing, and many old engines never had it applied, a few suggestions as to the best kind to adopt, and the best way to use it after it has been adopted may be of interest.

If rods were of exactly the same diameter throughout their entire length, and were in perfect alignment, the problem would be an easy one to solve, but inasmuch as many of them do not possess these desirable qualifications, and there is no prospect of their being supplied in the near future, it remains for us to adapt ourselves to circumstances, and make as good a job as possible with the materials at hand. If the rod is in first-class condition, almost any kind of packing will answer the purpose, but where it is scored or worn tapering, or is out of line, we must use a packing that will follow up the inequalities in its travel, and to do this without excessive friction the packing must be very elastic. The writer has found the following plan to be a very good one: Suppose that the stuffing box is 4″ in diameter, and the rod 2.5″, leaving a space three-quarters of an inch wide to be filled with

packing, and assume that the stuffing box is 3¼″ deep. Take a piece of pure gum rubber sheet packing, without cloth insertion, which is one quarter of an inch thick, and cut a piece from it 3″ wide, and of such a length that when it is rolled up into the form of a circle, it will form a bushing for the stuffing-box, reducing the space around the rod to ½″ in width. Care must be taken to cut this so that the ends will meet squarely, leaving no space between them, for this bushing of rubber must be a perfect fit in order to be effective. Next take a piece of firmly made packing, which is ½″ square, and cut rings enough to pack the rod out flush with the rubber bushing, which we made 3″ deep, thus taking six rings. These rings should be of such a length that when they are in place there will be at least one-eighth of an inch between the ends. They must never be cut so as to make a tight fit, although it makes a neater looking job in that way, for unless there is room for the rings to expand, the heat will cause excessive friction, sometimes to the extent of burning out the packing, and scoring the rod.

We have left a space three-quarters of an inch deep, which is sufficient for the gland to enter, but the nuts which hold it in place should not be screwed up with a wrench, but with the fingers only. If there is a leak of steam when the engine is started, it will do no harm for an hour or two, but if the expansion does not take it up then, the nuts may be screwed up until the joint is tight, but no further, for obvious reasons. If packing put in according to these directions does not abolish the disagreeable hiss of steam at each revolution of the engine, I do not believe that any other kind of fibrous packing will do it, and the rod should be turned true, and put into line.

So far as flange joints are concerned, it is a very good plan to have them ground so that no packing will be required, but as many of them which we must use are not built that way, it remains for us to select the packing which will render the best service. If the steam is not saturated with oil, we may select any elastic grade that is most convenient, but the flanges of the throttle valve, and any other that may be beyond the lubricator, must be packed with something that will not be dissolved by the oil. A corrugated copper gasket for each of such joints will answer a very good purpose, unless the faces are very rough. If we are to use soft packing, it is well to take a small piece of it, and put it in a cup of oil, and let it remain for about a week. There are several kinds in the market that will not stand this test, for when taken out there will be but little left of them, as they will be either partially or wholly dissolved, but others will be just as good as new after the test, and these should be used, exclusively.

Flange joints when newly packed should not be suddenly subjected to a heavy pressure, but should be warmed up gradually, and while still under a very light pressure, the nuts should be carefully screwed up until all of the lost motion caused by the relaxation of the packing is taken up. Under no circumstances is it proper to screw up these nuts under a heavy pressure, for if one of them should fail, the additional strain thrown on the others might cause them to break, and a serious accident would be the result.

In making up these joints do not begin on one side and screw up the nuts in rotation, as that will cause the flanges to be brought together on one side, and thrown open on the other, and then when this side is tightened up also, if it does not break the flange, it will cause a very heavy strain to be brought to bear on the bolts, much of which is entirely unnecessary.

In using old bolts for this purpose, they should be put in a vise, well oiled, and the nuts run down on them, until it is known that they are an easy fit a little farther down than they will ever be needed when in place. If this precaution is not taken, it is quite possible for the bolts to be twisted off before the flange is together properly.

In packing a cylinder head it is not necessary to have a large rubber gasket, as some asbestos wicking will answer every purpose at a very low cost. In packing a large valve stem, which is worn down, or has been turned down until it no longer fills the hole in the bonnet, a washer or gasket cut from thick pieces of cloth insertion sheet rubber packing will answer a very good purpose, if put in first, or if the gland is a loose fit, it may be put in last, to prevent the wicking from working into the space around the stem.

About Siphons—III.

BY LEICESTER ALLEN.

At the close of the previous article attention was called to the diagram illustrating the siphon as copied from Bartlett's Analytical Mechanics, which shows the delivery end of the siphon as below the surface of the liquid in the tank receiving the discharge. This was spoken of as significant of one of the disabilities of siphons. This disability only pertains to siphons the delivery ends of which are not submerged. It consists in a more rapid discharge from the delivery end than can be supplied, under existing conditions, by inflow into the opposite end. Referring again to Fig. 4, it will be easily understood that if the solid gravity pistons were, through some cause, to break into fragments, portions of which should fall out of the tube, allowing air to pass them and enter upwards into the tube from the discharge end, the pump would cease to work. Now, a siphon may, by improper construction, when the discharge end is not submerged, be made to act precisely in this manner. In Fig. 6 is shown an inoperative siphon. The discharge from the free end *b* is, in a siphon of this construction, so much greater than the inflow at *a*, that the liquid gravity piston in the branch *c b* drops out by piecemeal; and although the siphon begins to flow as soon as the end *b* is opened (the siphon being first filled and the end *a* being submerged in the liquid of the supply tank *A*), the flow ceases almost immediately, unless the siphon be so small that the leg *c b*, through its capillarity, holds the liquid column from breaking up. Through the effect of capillarity small siphons will often work, although their construction is so faulty that larger siphons constructed in the same way would soon cease to flow. In Fig. 7 is shown a reverse construction in which the supply end is made much larger than the discharge end, the latter being still free as before. Here the supply always being more than sufficient for satisfying the capacity of the discharge end, the siphon, if operating upon a liquid entirely free from absorbed gas and non volatile, will be continuously operative so long as the liquid in *A* is maintained at a level that will keep the end *a* submerged.

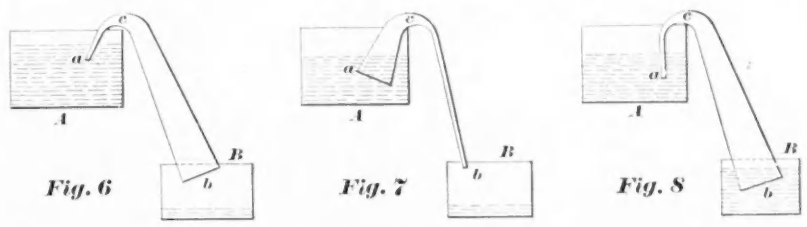


Fig. 6 *Fig. 7* *Fig. 8*

ABOUT SIPHONS.

Fig. 8 illustrates how the inoperative form of siphon, shown in Fig. 6, may be made operative by submerging the discharge end in the liquid of the receiving tank *B*. With a non volatile liquid containing no absorbed gas, the discharge of the siphon, thus constructed and arranged, would be continuous, so long as both ends are kept submerged.

A practical conclusion from what has been said is, that siphons will be more certain in their action when the supply end is larger than the discharge end, and when the discharge end is submerged. A regulating valve or cock, at or near the discharge end of the siphon, may be used to adjust the discharge and regulate it into proper relation with the supply. When this appliance is used, the pipe may be made of equal size throughout; and, in such case, the discharge end may be left free without cessation of flow, when the liquid to be siphoned is non-volatile and free from absorbed gas. The supply end may even be smaller than the discharge end when the regulating valve is used.

When the supply end of a siphon is only a little lower than the highest point of the bend, and when, also, the level of discharge is very much lower than the level of supply, if the discharge end be left free, and the caliber of the tube be of moderate size, the flow through it will be so free, and the supply will be so copious in proportion to the discharge, that, if the water flowing through the pipe be pure, the siphon may act satisfactorily for a long period. If, on the contrary, *h'—h* be quite small, and the caliber of the tube be large, the longer leg, if the discharge end be left free and unregulated by a valve, will be very apt to run out and render the siphon inoperative. It is scarcely necessary to add that any obstruction to inflow, such as the accumulation of silt in the supply end, or in any depressed portion of the tube, such as would form a trap wherein deposits of obstructive substances may collect, would produce a similar result. In such cases, a siphon, when refilled, may act for a time; but it slowly becomes inoperative provided the discharge end is not submerged, because the longer leg more or less gradually empties itself. This may be guarded against by a strainer placed over the supply end, but in many cases, the floating impurities in the liquid to be siphoned are so fine, that any strainer sufficiently fine to intercept them might itself become a sufficient obstruction to render the siphon inoperative.

We arrive, then, at the general principle, that the supply of liquid to a siphon must be greater than the flow which would take place from the discharge end of the pipe, provided the pipe were filled with the liquid, the supply end stopped, and the discharge end opened, when the discharge end is left free, unregulated and unsubmerged.

To illustrate this principle, let us suppose the extreme case of a siphon having a caliber of 1 foot, in which the difference of level, or between the point of supply and discharge (*h—h'*) is 4 inches. Let us further suppose this siphon to be at the sea level, and its highest point above the level of the supply to be 27 feet. Also suppose the discharge end of this siphon to be unregulated, unsubmerged. It would be inoperative because the water in the longer leg would not be held solid by the pressure of the atmosphere against it, and it would therefore break up and run out faster than it could be replaced at the inflow end under an effective head of only 4 inches.

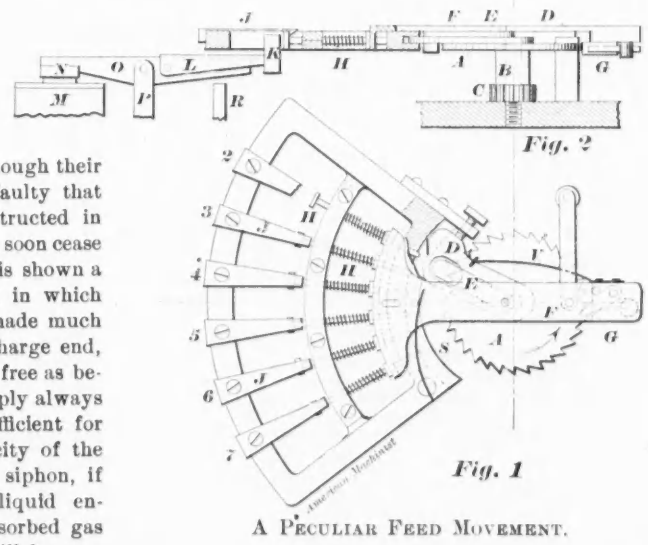


Fig. 2

Fig. 1

A PECULIAR FEED MOVEMENT.

A Peculiar Feed Movement.

BY C. L. REDFIELD.

Some time ago I had occasion to make a variable feed, and the problem to be solved was as follows:

There were six different degrees of feed required, varying by sixtieths of an inch from two-sixtieths to seven-sixtieths; the movement was to be made very quickly and instantly upon the selection of any particular degree of feed; the spacing required had to be accurate, and the mechanism used had to be without lost motion either at the beginning or after long use. The requirement that there must be no lost motion shut out all consideration of a force feed and reduced the matter to an escapement of some kind.

This problem I solved in the manner shown in the accompanying sketches, which are rather free copies from the working drawings. The escapement is controlled through a ratchet wheel *A* mounted on a sleeve *B*, the lower end of which has a small gear *C*. The gear *C* meshes into a rack, and at another place on the machine another gear and a clock spring put the rack under tension, the tendency of which is to turn the ratchet wheel in the direction shown by the arrow in Fig. 1. The wheel is held from turning by the pawl *G* on the bar *F*, which passes over the top of the ratchet wheel, and is free to reciprocate so as to release and stop the escapement. Pivoted to the under side of the bar *F*, and at about the middle of its length, is a small arm *E* that has a pawl at its outer end adapted to engage the teeth of the ratchet wheel when the bar is reciprocated to the left so as to disengage the pawl *G*, but which swings clear of the wheel when the bar is in the position shown in Fig. 1. Pivoted on the stud around which the ratchet wheel revolves is another arm *D*, located between the ratchet wheel and the arm *E*. The outer end of the arm *D* has a cam surface, and a little ways in from this cam is a slotted opening through which the pawl on the arm *E* reaches down to engage the teeth of the ratchet wheel. The result of this is to make the arms *D* and *E* swing together.

The quadrant that encircles part of the ratchet wheel, and in a groove in which the end of the lever *D* slides, supports a series of pins *H* that are held in the position shown by the spring catches *J*. The end of the bar *F* that extends over the quadrant spreads out in the form of a fan-tail and lips downward as shown in Fig. 2. The pins *H* pass through this lip and into the groove in which the cam on the arm *D* travels. Under each of the catches *J* is a hammer head *K* on the lever *L*, which is pivoted to the armature lever *O*. When the magnet *M* attracts the armature *N*, this hammer device stands in the position shown in Fig. 2, and when the armature is released the lever *O* rests on the post *R*, and the hammer head *K* is down away from the spring catch *J*. It will be noticed that the hammer head *K* is not shown in contact with the spring catch *J*, when the armature *N* is drawn down to the magnet *M*, and that apparently the action obtained would not release the catch from the head of the pin *H*. As a matter of fact, however, the action of the magnet is very quick and the momentum accumulated in the head *K* by being quickly moved serves to make the lever *L* swing on its pivot, when the lever *O* is suddenly stopped, far enough for the head *K* to release the catch. The instant the head *K* has made its stroke it falls

back into the position shown in the drawing, leaving the catch free to engage the head of the pin *H* as soon as it is moved back.

The six catches numbered from 2 to 7 represent the six different degrees of movement, and are controlled by six magnets and their corresponding hammer devices. In selecting any particular degree of feed movement the operator simply closes a circuit through the proper magnet when the operation is as follows:

The release of one of the catches *J* permits the corresponding pin *H* to be pushed inward by the spiral spring that surrounds it. This pushes the bar *F* to the right, releasing the pawl *G*, and causing the pawl on the arm *E* to come into engagement. The ratchet wheel is then perfectly free to revolve in the direction of the arrow, which it does carrying the arms *E* and *D* along with it. As the arm *D* moves around, the cam surface on its end comes into contact with, and pushes back, the pin that was released by the hammer action, until the head is again engaged by the catch. As the pushing back of the released pin leaves nothing to hold the bar *F* to the right, the spring *S* returns it to the position shown, causing the pawl *G* to catch into and stop the wheel *A*. It also releases the pawl on the arm *E* and permits the spring *V* to draw the two arms back again to their original position.

Releasing the catch marked 2 will permit an escapement of two teeth of the ratchet wheel, releasing catch 3 will permit an escapement of three teeth, and so on, the catch 7 letting go seven teeth.

A critical examination of this movement will show that it consists in freeing absolutely a ratchet wheel under a strong tension, and then catching into it while in full speed, and after any required number of teeth have passed a given point. One would naturally suppose that a catch the fleeting moments as they pass movement of this kind would be uncertain and liable to throw too much, too little, everything or nothing, according to the state of the weather, the temper of the operator or some other obscure reason. On the contrary it seems to be perfectly reliable, and since it was set up three years ago I have never known it to balk or throw any space but the proper one.

It is said that we learn more by our mistakes than by our successes, and one little thing that I overlooked when I first made this device points to a principle in mechanics too much ignored by designers, though seldom is it so vital as it was in this case. The gearing between the ratchet wheel and the carriage to be moved was such that each tooth of the ratchet wheel represented one sixtieth of an inch. The ratchet wheel had 32 teeth and the quadrant was indexed so that the divisions for the pins *H* would be 32 to the circumference. The device was set up and the first two or three movements were got right by grinding back the cam face until it corresponded with the "set" of the other parts. It was soon found that while the shorter movements were right, the longer ones were uncertain, sometimes moving right and sometimes too much, and that the longest movement was invariably too much. When my attention was called to this I supposed something was wrong with the fitting, and had the cam surface adjusted for the longest movement. As soon as this was done it was found that the shorter movements were not right. I then had the work begun from the middle when it was found that both ends were unreliable. For a time it did seem as if the thing would be a failure, but being one of those persons who will not desert a mechanism I have designed unless I know *why* it will not work, I started a little investigation into the nature of the action.

Those persons who know someting about inertia and accelerated motion will know what I found without any further explanation on my part, when I tell them that by having the quadrant indexed 37 to the circumference instead of 32 the difficulty entirely disappeared and no further trouble was found.

LETTERS FROM PRACTICAL MEN.

A Case of Power Transmission.

Editor American Machinist:

The article of Harris Tabor, in paper of the 12th, on "A Case of Power Transmission," recalls to my mind the interest I felt some twenty years ago when I first saw examples of an improvement on this case, for, as he says of this, "it was noisy in its action, especially where the wires cross the county road," in the cases that I saw that element was entirely lacking. The system was also a single wire one. The wire was hung from crossbars on a post, thus, by a small wire, and as there were no revolving parts except at wheel and the other end of the line, it was of necessity noiseless.

The wheel on the forward motion of wire performed the work connected to the system, and also raised a weight which, in its downward motion, would pull back the wire, and as the work was usually pumping, would push back the pump plunger ready for the next lift.

There were many cases of this in Westchester County, Pa., then, as I remember them, some a mile long, and, except as one caught sight of that swaying wire, unnoticeable. F. H. STILLMAN.

Fancy Wood Turning.

Editor American Machinist:

Being very much interested in all kinds of wood turning from the time I was a small boy to the present, and having a good opportunity to exercise on the lathe, both for profit and pleasure, I have at different times turned many novelties in wood.

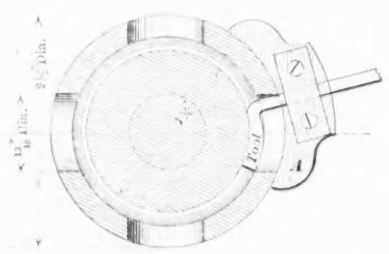


Fig. 1

Reading Mr. Charles W. Heald and William Newton's articles on wood turning I was very much interested, especially on the subject of a ball within a ball, and it set me to thinking how a perfect ball within a ball could be turned. Having a little leisure time I put my idea to a trial and produced a very nice example of a ball within a ball. This was accomplished with the aid of a small special tool as will be seen from the sketch Fig. 1. It is shown in position in the outside ball ready to start a cut.

The ball is first divided equally into six centers, then is placed in a cup chuck, so that a center runs true, a hole is then turned to the depth of the inside ball and to a diameter to allow the tool to enter. The piece *A*, Fig. 1, is made of wood and clamped on

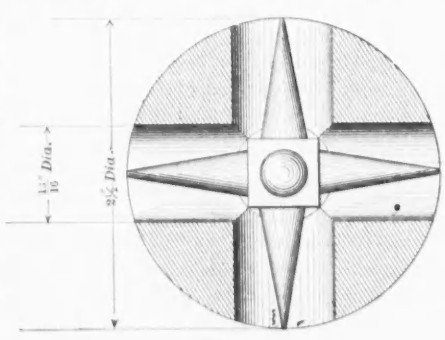


Fig. 2

the tool, and having the same curve as the outside ball when moved around within the limit of the hole, acts as a guide to the tool and forms the inside ball. The piece *A* rests on the tool rest, raising the cutting edge of tool up to the center of ball. The same operation being performed with each center the ball is almost loose; instead of cutting the ball entirely loose six small spots are left to hold the ball steady and guard against an accident while using the tool inside. These are afterwards cut out with a knife, leaving a nice true ball inside.

Fig. 2 shows another example of this kind of wood turning, which might be interesting to some, so I send it along. It is made in a cup chuck the same as the balls, but instead of cutting the wood all away in each hole, a small spire is left, and when the last one is done the piece is loose within the ball. There are six spires and they seem to be attached to a cube in the center of the ball as the sectional sketch will show.

Cleveland, O. W. M. FAWCETT.

More Personal History.

Editor American Machinist:

The history of "John Johnson," recently published in your paper, brings to my mind the rather similar experience of a mechanic of my acquaintance. The party in question, whom we will designate as R., commenced his mechanical career about fifteen years ago. He was at that time about 23 years of age, had learned no trade or profession, but had a decided leaning towards mechanics. He had married at the age of 22, and the increased expenses attending that condition of life, led him to make some effort towards bettering his condition.

Through the influence of a kind friend and neighbor, he secured a position as carpenter in a large machine shop, at a salary of $2.00 per day. The work he had to do here consisted not only of ordinary carpentering, but considerable millwrighting, varied by an occasional job of rough pattern-making, and was of such a nature as to bring him into close contact with machines and machinists. He became very much interested in the manipulating of these machines, and he lost no opportunity of investigating the why and the wherefore of any and every operation he saw performed in the shop. If he chanced to pass by when a floor hand was setting a valve, he would (if possible) stop to watch the operation, and on the first favorable opportunity would ask the workman many questions about the job he had just done, and would carefully store away the answers for future use. Seeing that most of the men in this shop received better pay than he did, a strong desire to become a machinist gained possession of him, but how to reach the desired end he did not know. Apprentices received but 75 cents per day, so that in his case an apprenticeship was out of the question, and as he had never done a day's work at the trade, a position as improver was equally so.

After much thought upon the subject, he resolved to serve an apprenticeship in a shop of his own, and this is how he did it: He hunted around until he found a party who had a small, second-hand engine lathe for sale; this he purchased for $40. The lathe was about 9" swing by 40" bed, and was a rather crude affair, being "home made." It was back geared, however, and screw cutting, although the screw gears were conspicuous by their absence. This gave him his first lesson in gearing for screw cutting. There was no index on this lathe, so he had not only to procure the gears, but had to find out what gears to get. After struggling through this forest of difficulties, he was pretty well grounded in the principles of screw gearing, and from that day to this has never met with any case of screw cutting or gearing that he could not master.

This lathe he rigged up in his cellar to run by foot-power; and here let me digress for a moment to remark that, as he informs me, he learned more about tool grinding in one month pumping that lathe by foot power than he would probably have learned in a year in a machine shop. If the tool was not cutting properly, the extra strain upon his muscles promptly informed him of that fact, and led to an investigation on his part as to the best shapes to use in cutting the different metals. He begged a small, worn-out, discarded vise from the superintendent of the machine shop, and with the addition of a few files, drills, etc., considered himself fairly on the road to success.

The first job he started on was to build a small steam engine 2" bore by 3" stroke. He took for his model one of the engines made by the company for whom he worked, and his work bench being in the pattern shop, he measured each pattern of this particular engine, and reduced it down to the size he contemplated building. Drawings he had none, that being an unknown art with him at that period, but that did not deter him as long as he could measure any part of the engine he was working from.

He made the patterns, had the castings made and commenced to fit up the engine, working nearly every night until 12 or 1 o'clock. As he proceeded with the job, he would take any small pieces he had made and show them to an old workman in the shop, with whom he had got on very friendly terms. The old gentleman would inspect and criticize the work, and show him how to proceed to remedy any defect he pointed out.

It soon began to be talked about in the shop of the carpenter building an engine, and when the engine was finished and ready to run, the tool maker, an old experienced jour., appointed himself a committee of one to investigate the matter and report back to the shop. He made the visit, and next day at noon time when he made his report, he said he was fairly astonished at what he had seen. He said the engine was complete in every respect, connecting rod fitted up with strap ends and gib and key, crosshead with adjustable gibs, piston with spring rings, and in fact everything exactly as on the regular engines built in the shop. He saw it run by steam and said it ran smooth and noiseless, and his last remark was—"the old man ought to see it."

After working this way for upward of two years, R saw an advertisement in the paper reading as follows: "Wanted a man who understands boilers and plain lathe work." He applied for the situation, thinking that if he could get some place where he was not known as a carpenter, he could evolute into a full fledged machinist. By some fortuitous chance he was selected for the position, and found it to be a sort of master mechanic or repair hand in a large factory situated in a small village some distance from New York. He found on reaching the place that they had a well appointed machine shop in a small way, having two lathes, a planer and drill press and plenty of small tools. There were two boilers and three engines scattered about the place, and it was to keep these in order and to make sundry tools used in their business that he was hired for.

Now commenced his battle in earnest. To do the work in hand satisfactorily, to drop no hint as to his being anything save a machinist, to keep his eyes open and learn all he could, this was the task he had before him. He tells me that, seeing a short time ago some of the work he did there in his first year, made him smile and wonder both at the verdancy of his employer and his own assurance in attempting the jobs.

He succeeded, however, beyond his utmost expectations, and at the end of a year received more pay. He now saw the necessity of a better education to fit himself for further advancement in his chosen trade. The plant was growing fast, additions were being made, and all the mechanical work fell upon him. Shafting had to be ordered and erected, speed of pulleys figured out, steam pipes for power and heating purposes arranged, and all the details of a power plant attended to. He had, shortly after commencing work in the machine shop, subscribed for the AMERICAN MACHINIST, and has continued to receive it to this day. This, he assured me, was at this period his sole mechanical library, and was his court of last resort in his tight places, and they were not few.

He now received good wages—about $1,000 per year—and was able to purchase books, tools, etc., as he required from time

to time. He became interested in the indicator from seeing it discussed in the AMERICAN MACHINIST, and decided to perfect himself in its use. He bought an instrument, paying for it in installments, and commenced at once to profit by its teachings. There was no one in his neighborhood to whom he could apply for advice, and thus thrown upon his own resources he studied both hard and long until he had mastered the problem. He referred very feelingly to the kind words and valuable assistance he received at this period from the present editor of the AMERICAN MACHINIST, and stated that among his most valued possessions was treasured a letter from that gentleman, in which he speaks well of the improvement he had made in the valve of an engine under his care, and the knowledge he had acquired in engineering.

After occupying this position for five years, he was offered the foremanship of a small machine shop in an adjacent town—one of those old-time country shops where they made any and everything (including an occasional assignment). Soon after taking this place he saw the necessity of not only being able to read drawings, but also of having the ability to make them. Not having the time at his disposal during the day—as he had to take hold and do a day's work as well as any hand in the shop—he started evenings to learn this necessary branch of the business, all alone. Procuring some drawing instruments, and believing in "Chordal's" view of the matter, viz., that "the way to learn to draw is to draw," he worked on that line. When an order was taken for a new job, he would take down the figures and then spend the night in making a drawing of the object. He now makes all the drawings and does considerable designing for a shop employing from forty to fifty hands, beside being the shop foreman and personally attending to all the details of an extensive jobbing business, as well as the manufacture of a special machine of his own design. I inclose you sample blue-prints made by him, so that you may judge if he has made progress enough to warrant him in styling himself a draftsman, also indicator cards showing his work in valve setting.

Whether he would have made a better showing if he had been regularly apprenticed to the trade when a boy, or not, is not very material; what is shown in his case is the fact that some men will work their way upward in spite of adverse circumstances, where others under more favorable auspices will remain stationary.

I may at some future time give you some account of the jobs he has accomplished and the means he adopted to do them; they are, however, so very much like Mr. Rogers' "Tom" that I should, perhaps, be accused of plagiarism. I will also try to send drawings or photos of some of the machines designed by him. The foregoing, Mr. Editor, is strictly true. "INDICATIONS."

Special Height Gauge—Honing Tools.

Editor American Machinist:

I have lately provided myself with a very easily made gauge for setting lathe tool to height of centers that may prove of interest to some of your readers. Mr. Frank Richards showed a template for a similar purpose in your issue of June 9, 1883, but some of your newly acquired readers may not have seen Mr. R.'s device, besides which mine is of a different order of architecture from his. When a piece of chuck-work requires to be faced clear across, and there is no hole in it, then it is necessary that the tool be at the exact height of the centers, or a small tit will be left in the middle of the work. My tool-post has the convex shoe business for altering height of tool, so the tool cannot be raised or lowered without loosening the tool-post screw, which I don't like to do in the middle of a finishing cut. I also like to start facing cuts from the outside edge, so I felt the want of some means of setting tool at proper height before starting the cut.

I found a piece of ¼-inch brass tubing in the scrap box, cut off a short length and faced both ends smooth. Then I put a sharp center punch in the chuck and fooled with it till I got it to run true, after which I used it to scribe some lines around the tube as shown in Fig. 1. The tail center could have been used for this purpose had it been sharp enough. The lines *A a* were scribed with tube standing on upper slide of slide-rest, while lines *B b* were scribed with tube

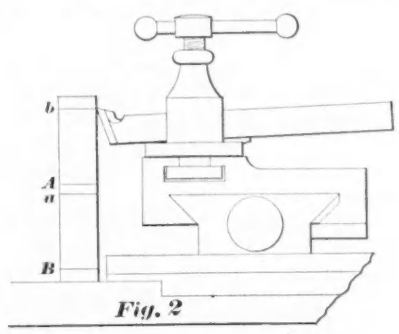


Fig. 2

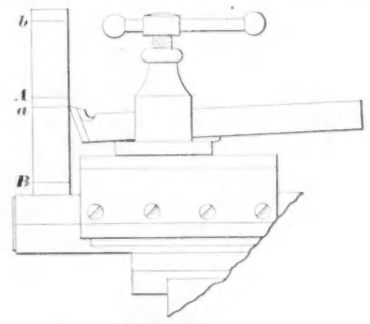


Fig. 1

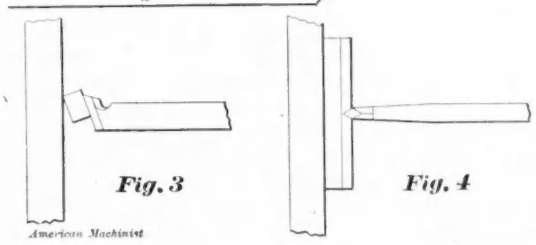


Fig. 3 Fig. 4

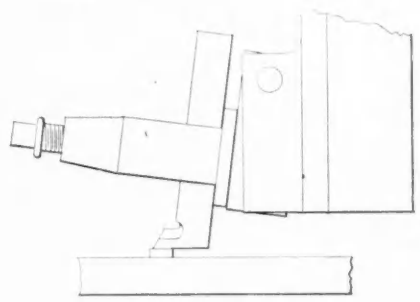


Fig. 5

standing on lower slide. One set of lines would have answered the purpose, but by duplicating them as shown the gauge may be used either end up.

To use it the gauge is merely stood on end on one of the slides, and the tool point set to the line as shown in Figs. 1 and 2, the former for a facing cut and the latter for taper work. The reason I like to feed from edge toward center in facing cuts is because the tool cuts free when near the center without having excessive clearance. Another reason is because my lathe faces slightly hollowing (a hardly perceptible amount) and in feeding toward the center the wear of the tool is in a direction to somewhat offset this, while if we fed from the center towards the edge we would get the *sum* of the two errors instead of their *difference*.

A good way to hone a lathe tool, according to my way of thinking, is to have a small oil slip (mine is about ¼"x⅜" in section) and rub this against the tool point after the tool is clamped in place and all ready to start the finishing cut. By holding the oil slip parallel with the slide we have a small flat parallel with the line of motion of the tool which produces a nice finish when properly done. The small flat wants to be as wide as the feed, but if much wider is apt to produce chattering. I generally hold the oil slip as near parallel with the slide as I can judge by eye, but where I want a particularly nice finish I place the oil slip between the tool and work as shown in Figs. 3 and 4, and give it a few horizontal strokes. The same thing can be done on a planer or shaper for getting a nice tool finish on the work. After the roughing cut, if the oil slip is laid on the work and the tool brought against it as shown in Fig. 5, a few strokes of the stone will hone the necessary flat. Of course the oil slip ought to have its opposite sides parallel and flat, and an occasional rub on a sheet of emery cloth laid on a surface plate not only tends to keep it in good shape, but also makes it cut well.

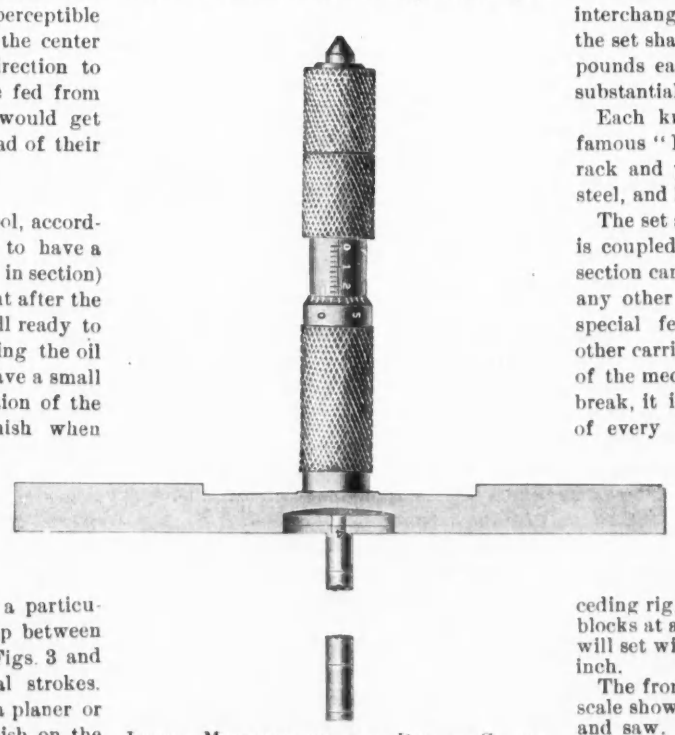
WALTER GRIBBEN.

Inside Micrometer and Depth Gauge.

In our issue of July 28, 1892, we illustrated and described a micrometer arrangement so made as to be used either as an inside caliper or as a depth gauge. This tool has been recently improved in such a way as to make it more convenient to use.

As formerly made there was some difficulty in readily reading the graduations because those that were inside the barrel could not be seen but had to be read by means of those outside. In the present tool this is overcome by making the tool to read in the same way as an ordinary micrometer, and the base lines, which are graduated upon the wire ¼" apart, are read by means of a line drawn upon the bottom of a circular gap cut out as shown so as to expose a portion of the wire. Arranged in this way the reading of the wire to the lowest mark expressed in thousandths of an inch is added to the reading of the micrometer.

When used as an inside caliper the base is simply unscrewed from the barrel when the wire and micrometer graduations are used in the same manner. The form of base illustrated is so made that the tool can be used as a height gauge as well, the base being hardened and ground true both top and bottom and to a thickness of just ¼". A base which is ground only on the bottom is also supplied when preferred. Three wires of varying lengths are furnished with each tool, and these are held in a split collet inside the barrel, which is tightened upon


INSIDE MICROMETER AND DEPTH GAUGE.

them by turning one of the knurled sleeves outside.

The internal arrangement of the tool is novel and ingenious, and is plainly shown in our issue mentioned above. It is made by J. T. Slocomb & Co., Providence, R. I.

From published extracts taken from Commodore Melville's annual report, it is evident he still keeps up the struggle for the recognition of the rights of the engineers of the navy, calling attention to the growing relative importance of the machinery of war vessels and the urgent necessity for properly recognizing this, and the fact that the outcome of future naval engagements will depend in an increasing proportion upon the engineer corps.

That Cheap Imitation of a Saw Mill Carriage.

NORFOLK, VA., Oct. 24, 1893.

AMERICAN MACHINIST, New York.

GENTLEMEN:—In your issue of October 19th is an article written by R. S. W., reflecting on a carriage being built in our shop. The writer describes it as a very cheap imitation of the Stearns carriage. In making this statement he shows his ignorance of carriages in general, and particularly of the Stearns, for in no feature (except being a carriage) does it resemble the Stearns. The "cheap imitation" was built for one of the largest and most particular (where good machinery is concerned) lumber concerns in this section, and was built *subject to approval* to replace a Stearns carriage, and has been accepted.

This is the second carriage we have built, the first one going into one of our leading mills, and has been pronounced by competent judges the best carriage on the river.

The writer has been engaged all his life in the saw-mill machinery business, seven years of it with Stearns Manufacturing Company, and believes that we are building the best carriage in the market. In writing you it is not our desire to make comparisons with other carriages, or to cast reflections on the Stearns which has been, and is still, one of the leading saw-mill carriages of the country.

We give below a few of the principal dimensions and weights of our carriage.

The timbers are made of 7"x10" Georgia pine, with heavy iron corner braces. The boxes have 10" bearings, are self-oiling, and provided with adjusting screw to keep out lost motion. The axles are steel 2½" diameter. The wheels are 14" diameter, and are made of *cast-steel*. The track is *planed-steel*, and weighs 30 pounds to the double foot. The head block bases are very heavy, weighing 710 pounds each. They have an 8½" opening to receive the knees, thus giving a good bearing. They are faced with steel where the log rests, and are provided with interchangeable bushings through which the set shaft passes. The knees weigh 500 pounds each and are all provided with a substantial taper movement.

Each knee is provided with either the famous "Reliance" or "Boss" dog. The rack and pinion *are cut* from *solid forged*-steel, and have 4" *face*.

The set shaft is steel 2 5/16" diameter, and is coupled in such a manner that any one section can be removed, without disturbing any other part of the blocks. This is a special feature and of great value. On other carriages should a spring, or any part of the mechanism that is keyed to set shaft, break, it is necessary to take out the keys of every pinion, the ratchet wheel and brake wheel, none of which is necessary in our case.

Our ratchet wheel is cut from *cast-steel*, and has a 6" face. Our pawls and arms are also of cast-steel. We use spring receding rig, with a brake wheel to stop the blocks at any desired point. The set works will set with absolute accuracy to 1/32 of an inch.

The front block is provided with a brass scale showing the space between the knees and saw.

As it is well known that we are the only concern in this section making any pretense to manufacture saw-mill machinery, the statement contained in the article referred to is calculated to injure us. We do not suppose that "R S W." had any such object in view, but that he was (vulgarly speaking) "talking through his hat"

Trusting that you will do us the justice of publishing our side of the question, we are,

Truly yours,

SOUTHERN MACHINERY CO.

JAS. H. KINK, Treas.

AMERICAN MACHINIST

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NEW YORK, NOVEMBER 2, 1893.

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More Wrecks.

Accidents to railway trains have become so frequent that it is difficult to keep track of them, and about the best we can do, apparently, is to hope that the near approach of the closing of the Exposition at Chicago means that our demoralized roads will soon again be carrying passengers with something like a reasonable assurance of safety.

Of course, there are the usual efforts to make it appear that these accidents are due solely to the culpable neglect upon the part of employes, or direct disregard of rules by them, but at the same time those who know anything whatever of railroad matters know that the primary cause of these accidents is the failure of railroad officials to make adequate provision for handling largely increased traffic. When we read of passenger trains running in ten or more sections, we know that that means over-time and extra runs for many trainmen; and the old question arises of the degree of responsibility that should be laid at the door of a man kept on duty continuously for twenty-four to forty-eight hours in a position where alertness and the full command of every faculty are imperatively demanded upon penalty of almost certain disaster. Then again, we all know that when roads are much overcrowded with business, rules must be more or less disregarded in order to handle the traffic at all, and railroad managers know that this disregard of rules by employes is often the only way of preventing an absolute block of all traffic. For the present overcrowding of the railroads, the policy of masterly inactivity during the spring and summer, by which they managed to discourage people from going to Chicago and concentrated the bulk of travel into the last two months of the Fair, is responsible.

At the same time, we are not unmindful of the fact that railroad men possess that common trait of human nature which makes us grow careless and reckless in the face of a constant danger, and that they are too apt to trust less and less to eternal vigilance and more to mere luck.

For instance, when trains are running on train dispatchers' orders, two copies of these orders are received by the conductor, and the supposition is that he hands one of them to the engineer, and that the two men then read them and compare their interpretations of them, in order to lessen liability of mistake in reading or significance. This is a good and proper safeguard, but any one who has traveled much has frequently seen an engineer receive a train dispatcher's order from the conductor, and at the same time take the conductor's statement as to contents of the order, starting his engine without so much as looking at the written order. In most cases the order is probably read immediately after starting, but in too many cases it is probably not read at all. In the case of the east-bound special Raymond & Whitcomb train which wrecked a west-bound excursion train at Battle Creek, killing over thirty people, there is, it is true, nothing to show that the engineer failed to read his orders, but he certainly did take the word of the conductor as to the west-bound train having passed; a matter about which he himself seemed in doubt, and which he should have known much more of than the conductor could know.

In another case—that of a collision which occurred on the Pennsylvania road—the accident is attributed to the circumstance that there was a dense fog which prevented the engineer from seeing the signal, which was set against him This, we think, is no excuse whatever. When there are signals in use, and an engineer knows that preceding trains depend for protection upon those signals, it should be his business to *know* the condition of every signal before passing it, and to stop his train while he climbs up the post to examine the signal, if he can ascertain its position in no other way. In this case the train was the "limited"; and it would be interesting to know whether if it were delayed, and the engineer gave as a reason: fog and difficulty of seeing signals, he would retain his place, or would be superseded by a man who never made any excuse for delay short of a break down or a collision. In any event, it is quite certain that Americans will, after this season's experience, be much less apt to boast of American railway management than they have been heretofore.

The fact that the cars of the R. & W. train in the accident first named above escaped without serious injury, and that none of its passengers was hurt, the cars of this train being vestibuled sleepers, while ordinary day coaches composed the other train in which the crushing and final roasting to death occurred, has brought out the usual crop of statements to the effect that vestibuled parlor and sleeping cars are practically indestructible in a collision, and that, therefore, all cars should be similarly constructed and vestibuled. It is, we regret to say, probable that before long we shall have a collision between two trains composed entirely of vestibuled parlor cars. When this occurs, it will then probably be made plain, as has been pointed out in these columns before, that the immunity of those who ride in vestibuled coaches is due to the fact that the common cars crush, and by giving away gradually bring the vestibuled cars to a stop. In other words, the superiority of the vestibuled car is much the same as was that of the iron-clad "Merrimack" before Ericsson's "Monitor" appeared. The tremendous energy stored in a heavy and rapidly moving train cannot be expended or absorbed within a distance of five feet or within a tenth of a second or less of time without serious disaster; and the reason those who ride in parlor cars are not hurt in collisions is because the process which crushes their less fortunate fellow beings allows this energy to be gradually absorbed.

Foreign Rascals.

A manufacturer of saw-mill machinery who had received an order from Amsterdam, Holland, wrote to our Southern contemporary, *Dixie*, calling attention to the fact, and rather congratulating himself upon the fact that the order was given without inquiry as to price, but was simply an order to ship and send bill, which he thought spoke well for the fame and name of the machinery made by him. Our contemporary, however, thought the circumstances were somewhat suspicious, and started an investigation, which resulted in the publication of a list of "doubtful merchants and swindlers" in Amsterdam, this list being obtained from the police authorities through the American consul at Amsterdam.

A prominent machinery manufacturing concern now calls our attention to this matter and suggests that we bring it to the notice of machinery men generally, which we gladly do. And first we cannot do better in the way of showing the proper course for a manufacturer in such a case than by publishing an extract from the letter of this manufacturing concern which shows its course in a similar matter. We quote from the letter as follows:

"We ourselves have but recently received an order from Rembrand & Co. amounting to over $500, but as we knew nothing of the concern, and they said nothing about payments we wrote them concerning that very important point, and were waiting for a response, when we happened to come across this article. We have just heard of another party that received a similar order under about the same circumstances, but whether from one of the parties named in this list we could not ascertain. We are led to believe that the business is being carried, or rather, attempted to be carried on more extensively than is generally known, and in these times when manufacturers are seeking orders from any source, and will perhaps take greater chances than in good times, the temptation to fill an order from one of these frauds, without ascertaining first just where a settlement is coming from, more especially if the order is written on a very prominent letter-head, gotten up to deceive, as was the case with the letter sent to us, would be greater than in ordinary times."

The Rembrand & Co. mentioned are included in the official list of swindlers, a list which includes 49 other names. We do not publish this list for several reasons, chief among which is that we do not believe it is a complete one, and we think it would be folly for an American manufacturer who should receive an order from Amsterdam to look over this list and, not finding in it the name of his proposed customer, fill the order without some assurance that the bill would be paid. It seems almost needless to say that merchants, the world over, at least those living in countries sufficiently advanced to want American machinery, are governed by practically the same business principles, and before ordering an article that they expect to pay for, carefully ascertain what its cost will be, and as much as possible regarding its quality. When an order is received from a concern which has evidently taken no pains to become informed on these important points, there is probably no intention of paying.

But we suppose there are about as many different ways of swindling known to Dutch and other foreign rascals as are known to those who have their habitat with us, and in view of this fact plain business common sense, such as was shown by the concern whose letter we quote from, will indicate the importance of having for every shipment of goods some assurance of payment for them. In the case of foreigners who propose to buy American machinery, a check or bill of exchange is sometimes deposited in an American bank, or with a reliable concern known to both parties, with orders to hand it over to the manufacturer or dealer upon receipt of bill with bill of lading. This protects both parties to the transaction, and is an arrangement which any foreign buyer should be willing to go into where he is unable to give assurance otherwise.

Literary Notes.

ADDRESSES DELIVERED BEFORE THE WORLD'S RAILWAY COMMERCE CONGRESS, HELD IN CHICAGO, ILLS., JUNE 19-23, 1893, UNDER THE AUSPICES OF THE WORLD'S COLUMBIAN AUXILIARY OF THE WORLD'S COLUMBIAN EXPOSITION. OFFICIAL REPORT.

This book will prove to be one of unusual interest to the railroad world, and all interested in railway commerce; it contains the expressions of thoughtful men, the leading representatives of the railway interests of all countries convened in the Art Institute Building in Chicago during five days of the week commencing July 19, 1893, for the purpose of mutual acquaintance, and the consideration of the means by which their common interests may be promoted, and their general welfare advanced. The topics relate to constitutional guarantees of railway properties, franchises, and rates against legislation spoliation; the proper protection of the public rights and interests involved in railway commerce, protection of private rights involved in railway commerce, principles of railway legislation; government regulation of transportation and its practical effect; statutory regulation of transportation and its results; economic laws governing railway operations; the effect of competition; prevention and control of strikes; safeguards against accidents; interstate railway arrangements, and various other subjects relating to railway management and operation. It also contains a railway history and development, showing the evolution of the American railway system; and papers treating on the influence of railways on new countries; influence of railways in Spain; the railways of Italy; railways of Sweden; and the railway system of New South Wales. The importance of these papers will be appreciated when the rapid developments of the railway business are examined. According to the statements in this book, the railway mileage of the world, at the commencement of 1893 was about 395,000 miles, representing a capital which may be estimated on the basis of the latest returns at about $25,000,000,000

The United States has now over 171,000 miles of railway, representing a capital of more than $11,000,000,000. The railway employes of the United States number about 850,000 men, and the railway employes throughout the world would form an army of 4,000,000. Every year, according to the average of the last five years, nearly 14,000 miles of railway lines have been built in this and other countries, and by this time, the total mileage of the globe will doubtless be at least 410,000 miles. We have no hesitation in saying that this book will be a valuable addition to the libraries of railroad men, and the public in general, as it gives a good idea of the vastness of the railroad business, and the many duties imposed upon the officers in charge of railroads. The book is published by the *Railway Age and Northwestern Railroader*, 1452-1456 Monadnock Block, Chicago, Ill. Price, $3.

ROLLER CHAIN GEARING, AS MADE BY HANS RENOLD. This is a pamphlet which treats of the subject indicated in an interesting manner and from a practical standpoint, most of what is here presented being derived from the author's practice in the making and use of such gearing, including the chains themselves, and the wheels upon which they run. Engravings and diagrams are freely used, and the book contains much that is of interest to those who have to do with such gearing. It is published by the author, Hans Renold, Manchester, England. Price, 1/6, or 36 cents.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(537) U. A., Wilmington, Del., writes: Kindly inform me if I can drive an emery wheel about 4 inches diameter by a flexible shaft fast enough for grinding the surfaces of hard dies, and can I handle the shaft running at such a high speed? The dies are of a shape which cannot be ground on an ordinary surface grinder. They are chilled and I want to grind off the high spots. *A.*—You can use a flexible shaft for the above purpose and handle it; in fact there are machines on the market for such work, which have flexible shafts attached to them.

(538) C. W. B., Grand Rapids, Mich., writes: Please give dimensions of an upright boiler suitable to run an engine with a cylinder 1½ inches diameter and 3 inches stroke. *A.*—Diameter outside of shell of boiler, 16 inches; height of shell, 32 inches; diameter of furnace, 10¾ inches; height of furnace, 18 inches; diameter of flue, 3¾ inches. 2. How much horse-power can this engine develop? *A.*—With a mean effective pressure of about 50 pounds, and running at speed of 450 revolutions per minute, about ½ horse-power, non-condensing.

(539) J. F. K., Jersey City, N. J., writes: In order to decide an argument between A. and B., kindly inform me, so as to satisfy both parties, which of the following definitions is correct? A. claims that the heating surface is every square inch of that which is touched by fire or gas on one side, and water on the other. B. claims that the heating surface is every square inch of that surface which is exposed to the fire and hot gases. *A.*—The heating surface in boilers is that surface which transmits heat to the water; hence it is the surface which is in contact with the water on one side and exposed to the heat on the other side. According to the foregoing A. is right. The heating surface is generally given in square feet and not square inches.

(540) W. B. H., Plainfield, N. J., writes: Please inform me what will be the required horse-power of an engine to run an air compressor having an air cylinder 20 inches diameter by 15 inches stroke; number of strokes per minute 160; pressure of the air delivered is to be 80 pounds. Also give formula for computing the same. *A.*—The compressor will deliver per minute say 81 cubic feet of air at a pressure of 80 pounds per square inch. The horse-power required to deliver one cubic foot of air per minute at this pressure, with no cooling of the air during compression, will be 1.25779; hence the horse-power required to deliver the given quantity will be $81 \times 1.25779 = 101.88$, say 102. Add 20 per cent. for friction. You will find a table of horse-power required to deliver one cubic foot of air per minute at a given pressure in our issue of March 30, 1893.

(541) A. X., Erie, Pa., asks: Can a cast-iron pulley 96 inches in diameter and 12 inches face be run safely at the rate of 600 revolutions per minute? *A.*—No. 2. What should be the dimensions of such to resist rupture from centrifugal face? *A.*—The dimensions of the rim have nothing to do with the resistance to rupture from the centrifugal force, or in other words, the increase of the thickness or the width of rim will also increase the centrifugal force, so that the resistance to rupture from centrifugal force will not be increased. This may be readily seen by the following formula for computing rim velocity of the pulley which gives results very nearly correct, it is,

$$v = \sqrt{\frac{s}{.1}},$$

in which v is the velocity in feet per second of a point in the center of a section of the rim, and s denotes the stress per square inch of section of the rim. Good American cast-iron should at least have an ultimate tensile strength of 20,000 pounds per square inch, but in the case of heavy pulleys, the metal in which has not been decarbonized at all by remelting, it is not safe to assume a greater ultimate tensile strength than 10,000 pounds. Taking a factor of safety of 4, we have for the safe working stress s, a value of 2,500 pounds and on this value the velocity of the rim depends. 3. If a pulley of the above dimensions cannot be run at the given speed, how fast can it be run? *A.*—Applying the foregoing formula we have,

$$v = \sqrt{\frac{2,500}{.1}} = 158 \text{ feet}$$

per second, or $158 \times 60 = 9,480$ feet per minute. Assuming this to be, for the sake of simplicity, the velocity of a point on the outside of the rim, and remembering that the circumference of a pulley 96 inches in diameter is 25.13 feet we have,

$$\frac{9,480}{25.13} = 377 \text{ revolutions per minute.}$$

In practice the velocity of the rim seldom exceeds a mile per minute; according to this rule, the number of revolutions per minute should not exceed $\frac{5,280}{25.13} = 210$.

(542) F. B., Buffalo, N. Y., writes: Please give me a rule for finding the area of a safety valve; also the rule for finding the stress on stay bolts. For example, the stay bolt is 1½ inches diameter; the stay bolts are placed 6 inches from center to center; steam pressure is 100 pounds per square inch, what will be the stress on the stay bolt? Please give a rule that is applicable to any size of stay bolt. *A.*—According to the rules and regulations prescribed by the Board of Supervising Inspectors of steam vessels, all lever safety valves attached to marine boilers shall have an area of not less than one square inch to two square feet of grate surface, and the seats of such safety valves shall have an angle of 45 degrees to the center line of their axis. Spring loaded safety valves constructed so as to give an increased lift by the operation of steam, after being raised from the seat, shall have an area of one square inch to 3 square feet of grate surface. There are other rules for computing the area of a safety valve, but the foregoing are easily remembered and ample in size for any requirement. We do not recommend safety valves of a greater diameter than 4 inches; if valves greater than this are called for by the foregoing rules, more than one valve of a smaller diameter should be used. The stress in the stay bolt in the given example is found as follows: The stay bolts being placed 6 inches from center to center, each bolt has to support a surface of $6 \times 6 = 36$ square inches, the steam pressure being 100 pounds per square inch; the total stress on the stay bolt will be $36 \times 100 = 3,600$ pounds; the cross-sectional area of the stay bolt 1½ inches diameter is .99 square inch; hence the stress per square inch of stay bolt will be $\frac{3,600}{.99} = 3,636$ pounds. If the stay bolt had been one inch in diameter, the cross-sectional area of which is .78 square inch, the stress per square inch would have been $\frac{3,600}{.78} = 4,615$ pounds. If the 1½ inch stay bolts are placed 6 inches from center to center in one direction and 4 inches from center to center in a direction at right angles to the former, then the surface which each bolt will have to support will be $6 \times 4 = 24$ square inches, and the total stress on the bolt will be $24 \times 100 = 2,400$, and the stress per square inch of cross section will be $\frac{2,400}{.99} = 2,424$ pounds. From the foregoing we have the following rule: Multiply the number of square inches in the surface which the bolt has to support by the steam pressure per square inch, and divide this product by the cross-sectional area in square inches of the bolt; the result will be the stress in pounds per square inch of the cross section.

(543) H. B. H., Cleveland, O., writes: In reply to Question 493 in your issue of October 5th, you say that you would make the thickness of metal of the hydraulic cylinder 1⅛ inches, and further on the correspondent speaks of making the cylinder of cast iron. The formula I have used and seen used for cylinders when simple ordinary accuracy is desired is $t = \frac{p \times r}{\frac{1}{6} \text{ tensile strength}}$, in which t denotes the thickness in inches, p the pressure per square inch, and r the inner radius in inches of the cylinder. Looking over your issues of the past and comparing notes, I find that the assumed ultimate tensile strength of cast-iron is 15,000 pounds. Applying the above formula I get $t = \frac{1,500 \times 6}{2,500} = 3.6$ inches. Now what I wish to know is, am I wrong or is there a typographical error in your answer? Please explain, also give formula which is in accord with the best practice of to-day. I am aware that the above formula is not correct and can only be used as an approximation. *A.*—Your formula is correct enough for computing the thickness of cylinders subjected to comparatively low internal pressures. In fact this formula is used for finding the thickness of steam boiler shells; the U. S. Board of Supervising Inspectors gives this formula for computing the thickness of single riveted boiler shells, and also allows one-sixth of the ultimate tensile strength of the solid plate as you do for cast iron. But it must be remembered that the plates in a boiler are much weakened by the rivet holes, and since the strength of the boiler depends on its weakest parts, it is evident that the factor of safety is not 6, as it might appear to be, but in some cases this factor of safety may not exceed 3. In a cast iron cylinder we have no riveted seams to allow for, and therefore, we may take a much lower factor of safety. It is true that the ultimate tensile strength of some brands of cast iron is 15,000 pounds per square inch, but such a quality of cast iron should not be used for hydraulic cylinders; the iron used for this purpose should have an ultimate tensile strength of 25,000 to 30 000 per square inch, and adopting a factor of safety of about 3 we may take the safe working stress to be 10,000 pounds per square inch. If we now wish to compute the thickness of a hydraulic cylinder 18 inches in diameter, subject to an internal pressure of 1,500 pounds per square inch, we have according to your formula, and by substituting 10,000 for 2,500, $t = \frac{1,500 \times 6}{10,000} = .9$ of an inch instead of 3.6 inches. But for comparatively high pressures, this formula is, as you say, not correct. The following formula, which is generally used for computing the thickness of hydraulic cylinders of cast-iron, gives safer results:

$$t = \frac{p \times r}{10,000 - p}.$$

In which the letters denote the same quantities as before. According to this formula, we have:

$$t = \frac{1,500 \times 6}{10,000 - 1,500} = 1,059,$$

or nearly $1\frac{1}{16}$ inches; to be on the safe side we call it 1⅛ inches. You will find that for very low pressures both formulas give about the same results, and as the pressure is increased, the difference in the results becomes more marked, as it should do. 2. You speak of using for the hydraulic packing a leather ring of U-shape. I have seen rubber used for the same purpose. Can you give me any information in regard to the life of such packing, made either of leather or rubber? Also give the thickness required. *A.*—The life of the packing depends on so many things that it is impossible to give any reliable information on this point. Poor leather should never be used, for such will always be a source of trouble. The packing should always be cut from the back of the hide, not from the neck; if cut from the latter, the packing will begin to leak in a very short time. The life of the packing also depends on the frequency of using the ram or press, and also on the kind of liquid used; if oil is used, the packing, with good care, may last from two to three years; if water is used containing grit, as is sometimes the case in rolling-mills, the packing may not last two or three months. The thickness of the leather packing depends, to some extent, on the diameter of the ram, for a ram 9 inches diameter a thickness of $\frac{7}{32}$ has given satisfactory results. Of course, for much smaller rams we should use leather of less thickness. Although we have not had much experience in using rubber for the packing, we have no doubt that in some hydraulic machinery it can be used with advantage; but its life, like that of the leather packing, depends much on the conditions under which it is used.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N.J.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Milling Machine Feeds.

BY FRANK RICHARDS.

IN WHICH DIRECTION SHALL WE FEED THE WORK TO THE MILLING CUTTER?

This is my "small contribution" to the "explanation" that Mr. Fred. H. Colvin invites in the AMERICAN MACHINIST, October 5th.

Not long ago I served a month as a juror in a New York court. I came out of the experience with a greatly increased respect for the machinery of the law. I was probably most impressed by the fact that to secure a fair trial the whole court is necessary. We need not only the judge and jury, but all the witnesses and the fullest argument of counsel on both sides. When we are trying the mechanical questions that come up, we are too much in the habit of trying them without the full court. The judge is present, of course, and generally a pretty fair jury, but we don't make much effort to get in all the evidence, and it is seldom that the counsel on both sides have a full and respectful hearing, and that is why we have so many mistrials and so often have to go over a case again, because nothing in the world is settled until it is, as we say, settled right; that is, nothing is settled until it is settled.

Now here is this milling machine question. It has come up in an informal way to almost every machinist, and there has never been any difficulty about settling it right on the spot, and the result is that the question is rather more alive as a practical question than ever before. You can't feed the work the same way the cutter is going on account of the "backlash" or "lost motion" in the feed. The motion of the cutter will drag the work ahead, and then the cutter will be choked and the machine will be stalled. Anybody who has accidentally turned the crank the wrong way when he wanted to run the platen back knows all about that, and there isn't a chance for an argument. But they are feeding the work the other way, and doing it more and more, and they don't have any trouble about the backlash, and it would seem that there really is a big opening for discussion.

But what is the use of arguing it, any way? Feeding the work against the cutter is the way that has been established by long experience, and it is giving us excellent results, and why not let well enough alone? "Well enough" is the one thing in the

world that is never let alone. The better way is knocking it out every day, and better results are loudly and confidently claimed by some of the most eminent and successful mechanics for the new way of feeding.

It can't possibly make any difference in the wear of the cutter, you know, which way the work is fed to it. And yet it is strongly asserted that it does make a difference, and that the cutters keep sharper and last longer with the new style of feed. This is worth looking into, because it is probable that this is the determining consideration for or against the change of feed. There should certainly be some proof or strong presumption of advantage before making such a radical and general change of practice.

Referring to the accompanying sketches, which it was necessary to make much exaggerated so that the *points* would be visible, Fig. 1 shows the work being fed with the cutter, and in Fig. 2 the work is fed against the cutter, in the good old way. It must strike one at once that the assertion that the direction of the feed can't affect the wear of the cutter is a hasty or thoughtless one, for it is evident that neither the clearance of the cutter nor the cutting face have identical relations to the cut in the two cases, and if the cutting action is different the wear may also be different.

Fig. 1 shows one tooth of the cutter at *b* as having just begun its cut. The tooth immediately before it also began its cut at *b*, and while this tooth has been moving from *b* to *c*, the point *b* has been advanced by the feed from *b* to *a*, leaving the distance *b a* as a bite for the cutter now beginning its work. While the actual path of each cutting tooth is along the circular line *o x*, the path of the first tooth with reference to the work is represented, approximately, by the line *a c*, that of the tooth before it by the line *e i*, and so on. If we start at *b a* and follow any tooth down along its whole cut, we notice that with a constant feed the cut is heaviest at *b a*, where it begins, and that it constantly diminishes until it is lost when the horizontal line is reached.

Going over the path of the cutting tooth again, we notice that as the cut diminishes the clearance at the heel of the tooth constantly increases. The clearance is least at the beginning when the cut is heavy, and is greatest when the cut is light. The cutting face has the most support when it is most needed, which is as it should be. If, then, there is sufficient clearance at the beginning of the cut, there is certainly enough for all the rest of the cut. No one has been able to state how minute the clearance may be so that there is actually some clearance. In this case, if we start with no clearance we certainly have a theoretical clearance as soon as the tooth has made any advance, and must have more as we go along, and who shall say that if at the moment of contact we start with the shape of the heel of the cutter exactly coincident with the path of the cutting point in contact with the metal, we have not sufficient clearance for the whole cut? Now besides the consideration about the lost motion in the feed preventing our feeding the work with the cutter, the other principal argument against the practice lies in the assertion that it won't do to mill a raw casting in that way, because the scale of it will use up the teeth of the cutter in less than no time. Supposing the top of the casting to be flat and horizontal, or nearly so, and the face of the tooth to be radial, the extreme point of the tooth will be the first part of it to come in contact with the casting. As the tooth crushes down into the metal, and in contact with the scale and dividing it as it goes, the portion of the scale in front of the advancing face has a contact of pressure only, while the edge of scale still uncut upon the casting has a sliding or frictional contact with the heel or clearance face of the tooth, and undoubtedly accomplishes some abrasion of that face. Why may we not say that our piece of cast iron with its shell of scale is thus providentially provided with a hardened plate upon its surface, to serve as a constant sharpener for each cutting tooth?

Fig. 5

Fig. 3

Fig. 4

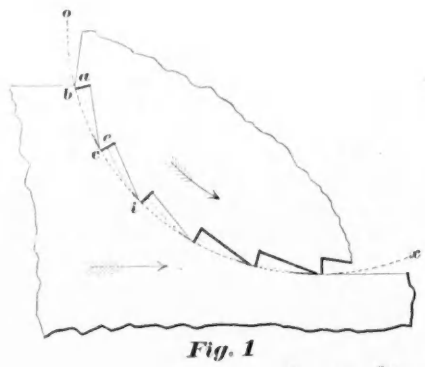


Fig. 1

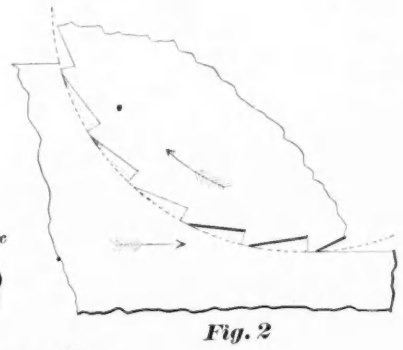


Fig. 2

MILLING MACHINE FEEDS.

If now we look at Fig. 2, in which the work is fed against the cutter, we notice that here, too, the clearance is least where the cut is heaviest, or where the cut is heaviest the cutting edge has the best support, the same as when feeding against the cutter, but in this case the heaviest part of the cut is at the last of the cut instead of at the first of it as in the other case. The cut is an increasing one instead of a diminishing one, and it does not appear why one may not be just as good as the other so far as either may affect the wear of the cutter. The important difference to be noted in the two cases is in the first approach and first contact of the cutting edge with the work. While I have suggested that when feeding in the same direction with the cutter, the scale upon the surface—the bugbear that has sufficed to deter many from trying the forward feed—may have a sharpening effect rather than otherwise upon the cutter, I am probably stronger in the conviction that when feeding against the cutter the first contact of the tooth has a more wearing or dulling effect upon the cutting edge than all the subsequent work. The apparently plane surface that is left by the milling cutter actually consists of a series of ridges or waves, the measure of each ridge corresponding with the distance fed during the passage of each tooth. These ridges or waves are never perceptible to our senses, if indeed they could be discovered by any instrument. The ridges that are sometimes discoverable upon milled work represent successive revolutions of the cutter with some attendant eccentricity or irregularity, instead of being due to the passage of the single tooth, still undoubtedly the ridges exist with the actual angle and the curved hollow between them, something as in Fig. 3.

When the tooth begins its cut, the surface that it strikes is so nearly tangent to the circular path of the cutter that there is probably a moment of sliding contact before the tooth encounters enough material to "hold the cut," and at this moment a little abrasion of the sharp cutting edge occurs, and the plane of this abrasion is a little in advance of the tangent, or, assuming the face of the tooth to be radial, the angle with the face will be slightly less than a right angle. Thus what we might call a reversed clearance is put upon the cutting edge, and nothing more favorable and inviting to additional subsequent wear could well be imagined.

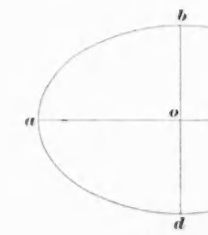


Fig. 1

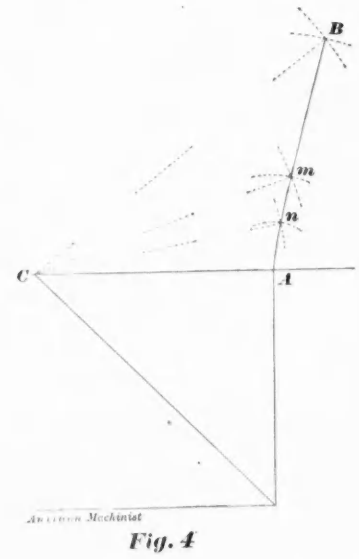


Fig. 4

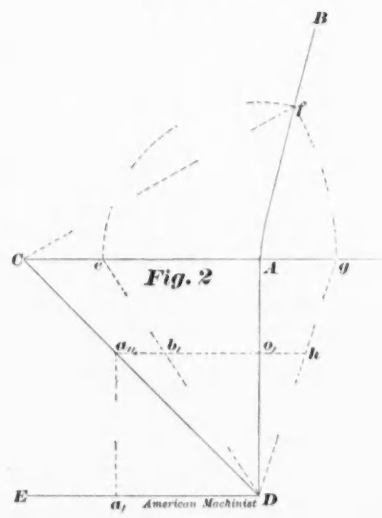


Fig. 2

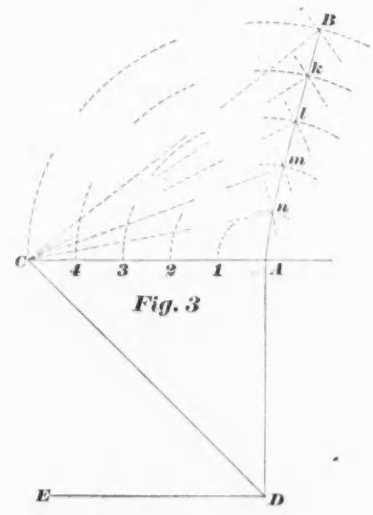


Fig. 3

RECTIFICATION OF THE ELLIPSE.

The slightness of the angle at which the tooth approaches its work when feeding against the cutter is not fairly represented in Fig. 3, and will be better appreciated if we assume the movements of both the cutter and the work to be in straight lines, as upon the planer. Fig. 4 shows the cut when feeding with the cutter, and Fig. 5 when feeding against the cutter. In Fig. 4 the tool plunges right into the material and goes along about its business without any nonsense. Fig. 5 will speak for itself to any one who has had any experience with a planer. It is not necessary to say a word about how hard it is upon a tool to have to enter a cut at such a minute angle. No matter whether there is a scale upon the surface or not, the tool will not take hold in a clean, sharp, and decisive way, but must have a time of sliding and jumping before it gets into the cut, and the edge wears off rapidly. A flat nosed tool, corresponding to the tooth of the milling cutter, is much more exasperating in its action under these conditions than a round-nosed tool or a sharp-angled tool like a "diamond point," as every machinist knows. We can well sympathize with a cutter that has to meet such experience all its life long.

I can't help believing that those fellows are right when they tell us that the cutter will keep sharp longer and wear better, or wear less, if we feed the work with the cutter, and I think we should adopt their practice as fast as we can muster the courage to do it. I didn't set out to argue the case *pro or con* or *pro and con*, but just to state some of the points of it as they occurred to me. But it seems to be that stating the case is arguing it, and, in fact, giving the facts is all the real argument that any case admits of. We can't be too careful of our facts. I have offered here some points that are, unfortunately, only assumptions. There is room for some one of extensive actual experience with milling cutters to contribute something more incontrovertible.

P. S.—I have not said anything here about the means of doing away with the "backlash" in the milling machine. This would do for one of Mr. Leicester Allen's problems for developing the inventional faculty. Where a weight is used to take up the backlash, as already suggested by one or two writers, why not use the weight to pull the platen forward and take up the lost motion in advance, instead of using it to pull backwards in resistance to the action of the cutter? If used to pull ahead, the weight required would be practically constant and could be easily ascertained. If applied to resist the advance of the platen, as seems to have been done by those who have mentioned it, the weight required would seem to be uncertain and its action unsafe.

Rectification of the Ellipse.

BY FREDERIC P. HONEY.

In mechanical drawing it is sometimes required to rectify an ellipse or a part of one.

This exercise occurs in developing the surface of an oblique cylinder. The right section is an ellipse, the length of the circumference of which is the length of the envelope.

It is therefore important that we should be able to measure this curve accurately and quickly.

The length of a quadrant of an ellipse is found by the integral calculus.*

It is equal to

$$\frac{\pi}{2} A \left[1 - \frac{e^2}{2^2} - \frac{3.e^4}{2^2.4^2} - \frac{3^2.5\,e^6}{2^2.4^2.6^2} - \propto c\right]$$

in which A is the semi-major axis and e the eccentricity.

When there is a great difference between the lengths of the axes the mathematical work is very laborious, since a large number of terms of the series must be computed in order to obtain an accurate measurement.

Before explaining the construction and analysis of Fig. 3 I will show how the draftsman may use it in rectifying a quadrant of any given ellipse, referring to Fig. 2, which is a fac-simile of Fig. 3.

A B, *A C*, *A D*, *C D* and *D E* are the permanent lines of the figure. The lines which are represented broken and dotted may be drawn lightly in pencil in measuring the

*See Bowser's Dif. and Integ. Calculus, p. 350 seq., or Loomis' Anal. Geom. and Calculus, p. 250 seq.

curve. They should then be erased, leaving the figure ready for future use.

Let it be required to measure a quadrant of the ellipse *a b c d*, Fig. 1.

Lay off *D* a_1, Fig. 2, equal to the semi-major axis *o a*. Draw $a_,$ $a_{,,}$ perpendicular to *D E* intersecting *C D* at $a_,$. Draw $a_{,,}$ $o_,$ parallel to *E D* and lay off $o_,$ $b_,$ equal to the semi-minor axis *o b*. Draw *D* $b_,$ and produce it to *e*. From *A* as a center with *A e* as a radius draw the arc *e f* intersecting *A B* at *f*. From *C* as a center with the radius *C f* draw the arc *f g* intersecting *C A* produced at *g*. Join *D g*. This line intersects $a_{,,}$ $o_,$ produced at *h*, and $a_{,,}$ *h* is the quadrant rectified.

CONSTRUCTION AND ANALYSIS OF FIG. 3.

Draw the straight line *A C* any convenient length. In order to make accurate measurements this line should be longer than the semi major axis of any ellipse which the draftsman may be required to rectify.

To construct the line *A B* divide *A C* into any suitable number of equal parts at the points 1, 2, 3 and 4. The number of divisions depends upon the size of the figure, and will readily be determined by the draftsman. Rectify a quadrant of an ellipse whose semi-major axis is equal to *A C* and semi-minor axis equal to *A* 1. With this length as a radius from *C* as a center draw an arc. From the center *A* with the radius *A* 1 draw an arc intersecting the former at *n*. Similarly rectify the quadrants of the ellipses whose semi minor axes are *A* 2, *A* 3 and *A* 4, having the common semi-major axis *A C*. With these measurements as radii from *C* as a center draw arcs. From *A* as a center with radii equal to *A* 2, *A* 3 and *A* 4, draw arcs intersecting the former respectively at *m*, *l* and *k*. Also from *C* as a center with a radius equal to the length of a quadrant of a circle whose radius is *A C* draw an arc intersecting at the point *B* the arc *C B* described from the center *A*. *A B* traced through the points *A*, *n*, *m*, *l*, *k* and *B* is the required line. *A D* is drawn perpendicular to *A C*, and *C D* at any convenient angle to *A C*. Draw *D E* parallel to *A C*.

If the line *A B* be carefully constructed it will be the locus of a point at the intersection of an arc described from *A* as a center with a radius equal to the semi minor axis of an ellipse, and of an arc described from *C* as a center with a radius equal to a quadrant of the ellipse rectified, the semi-major axis being equal to *A C*.

In order that the figure may be applicable in measuring *any* ellipse, the directions given above must be followed. For it will be seen that while *C g* (= *C f*), Fig. 2, is the length of a quadrant of an ellipse whose semi major axis is equal to *A C* and semi minor axis *A e*, $a_{,,}$ *h* is the length of quadrant of an ellipse whose semi-major axis is equal to $o_,$ $a_{,,}$ and semi-minor axis $o_,$ $b_,$, the lengths of the circumferences of ellipses whose axes are in the same proportion being proportional to the lengths of their axes.

For small work the following approximation will give accurate measurements.

Draw *A C*, Fig. 4, = 10″. From *A* as a center with radii of 2″, 4″ and 10″ draw arcs of circles. From *C* as a center with radii of $10\frac{7}{8}$″, $11\frac{1}{2}$″ and $15\frac{7}{10}$″, draw arcs intersecting the former respectively at *n*, *m* and *B*. Join *B m* by a straight line, and draw an arc of a circle through *m*, *n* and *A*. *B m n A* approximates the locus nearly enough for practical purposes in measuring the length of the entire circumference. It is evident that the *total* length of the circumference of the ellipse may be obtained by laying off twice the length of the major and minor axes instead of one half in each case in rectifying the quadrant.

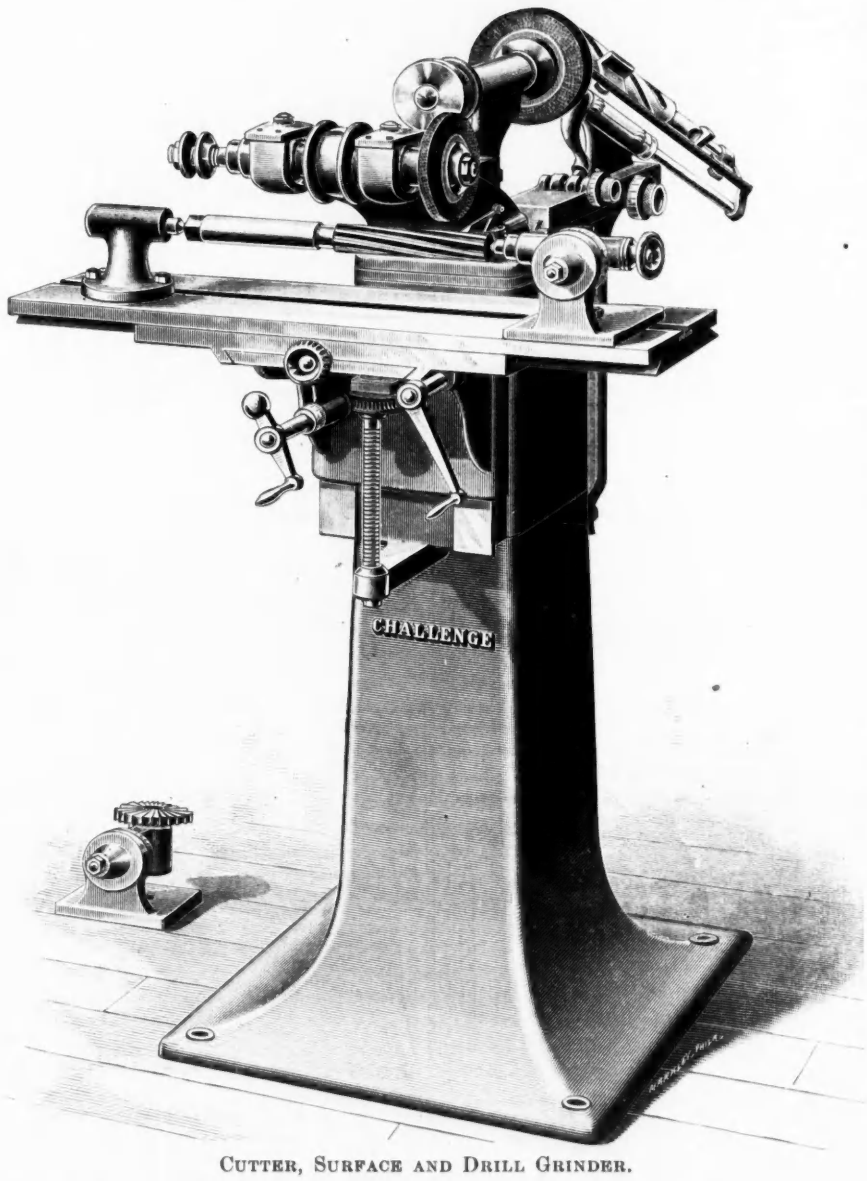
The new Cunard racer, the "Lucania," seems to have gone into the business of record breaking, and on her return trip after lowering the westward record, she further distinguished herself by lowering the eastward record 1 hour 35 minutes, her time being 5 days 13 hours 30 minutes.

The westward record of this vessel of 5 days 13 hours 45 minutes was beaten almost as soon as made by her sister ship, the "Campania," whose time on her last westward trip was 5 days 13 hours 23 minutes.

There are those who talk of five-day steamers as among the near by probabilities, but when we reflect that these two vessels have 30,000 horse-power engines against the "Paris" 20,000 horse power, and have succeeded in lowering the "Paris" record by only one hour one minute, it does not seem to promise a very early cutting off of the remaining 13 hours 23 minutes.

Cutter, Surface and Drill Grinder.

We illustrate herewith a grinding machine which has two wheel spindles placed at right angles to each other, as shown, one of these being for grinding twist drills, while the other is for cutter, reamer, surface and general grinding, these spindles being separately belted, so that either or both may be used without reference to the other.



CUTTER, SURFACE AND DRILL GRINDER.

In grinding drills it is only necessary to set two graduated disks to lines corresponding to the diameter of the drill to be ground, and its range is from $\frac{1}{8}$″ diameter up to 2″, the drill being simply laid in V rests and the lips brought in succession against a rest, when by a swinging motion of the support the proper form is given.

In doing surface grinding the work is clamped to the table or held in a chuck, the vertical movement of the knee by which the desired thickness is obtained being by worm, wheel and screw, the cross movement by screw, and the traverse movement by rack and pinion.

This latter movement is also, of course, the one used in grinding reamers or cutters after the proper adjustments are made.

Tapers can be ground by elevating or depressing the center at the right, and cutters are ground by the use of this head alone, which can be fitted with suitable arbors and set at any desired angle.

That portion of the column which supports the knee is in reality a sleeve that fits over a cylindrical section of the columns, and thus this sleeve with all its attached parts can be swung around the column to any desired position and clamped, the heads carrying the wheel spindles remaining stationary, thus permitting any desired relative position of wheel and work.

The builders are the Appleton Manufacturing Company, Philadelphia.

Study of the Calculus.

At the regular meeting of the Association in Nashville, Tenn., October 12th, Vice-President W. T. Magruder in the chair, Prof. Wm. W. Carson, of Knoxville, Tenn., presented a paper entitled, "A Plea for a More Rational Presentation of the Calculus." The beginner in the calculus finds the continuity of mathematical science broken, and, instead of meeting the characteristic clearness of proof, is surrounded by perplexity and darkness. The author investigates the causes of this state of affairs, and proposes a remedy. The demonstrations of the calculus of to-day rest on limits, or on infinitesimals, or on both. The former proves the formulæ, without giving any foundation or explanation of the nature of the calculus; the latter explains, but does not prove, yet as it leads directly to true results, it is accepted. Proofs by limits, when sifted down, rest on slippery definitions and ambiguous language; infinitesimals are invested with the property of changing their magnitude from the considerable to the inconsiderable whenever convenient. The author repudiates the doctrine of infinite quantities, both infinitely great and infinitely small; such classification is artificial and useless. The equations of the infinitesimal calculus are false to him who understands the *dx's* and the *dy's* to stand for infinitesimal increments, though true to him who understands them to stand for something else, and it is by performing the operations of the latter's conception that true results are obtained. Instead the author would introduce *hypothetical* quantities. A real occurrence takes place by a continuous change of conditions, and in a real magnitude the conditions are different for the different parts; the hypothetical quantity is what we suppose would exist under a reduced number of conditions actually obtaining in the real quantity, hence is simpler than the real. The calculus is defined as "that branch of mathematics which connects real and hypothetical quantities." The problem of the differential calculus is—given the real quantity, to find the hypothetical; that of the integral calculus—given the hypothetical, to find the real. The investigator desires to find a certain real magnitude, which, by reason of the complexity of the conditions, is beyond the reach of his other mathematics; he turns to the hypothetical, and considers a magnitude similar in nature to the real, and that would exist if the conditions were less complex; if this simpler magnitude is within the reach of his mathematics, he passes, by the rules of integration, to the real, otherwise the process of the hypothetical is repeated until the conditions are sufficiently simple, then, by a sufficient number of integrations, the real is reached. With this conception of hypothetical quantities, are logically derived the equations gotten by the limit calculus, and what its "derivatives" are is shown; multiplying these equations through by *dx* gives the equations used in the infinitesimal calculus.

The Association will next convene at the annual meeting, Nashville, November 9th.

WALTER G. KIRKPATRICK, Sec.

Cash Registration, or Mechanics Applied to Prevent Errors and Stealing.

BY AMBROSE WEBSTER.

The importance of mechanical cash registration has come to be so generally recognized by the business public that hundreds of inventors are studying the subject. During the year 1892 there were 163 patents issued in the United States alone, pertaining to machines of this class, and perhaps as large a number were issued in other parts of the world.

The first step towards cash checking was made by the Chinese in the early part of the fifteenth century, and consisted of numbered balls strung on a series of quadrant-shaped rods. This developed with the Chinese into their pin-wheels, which were capable of adding, subtracting, multiplying and dividing numbers.

The second step was made by a ship chandler in London, Eng., in the early part of the nineteenth century, who then introduced into England an alarm cash drawer, provided with a three keyed combination lock to work the alarm, so that any person attempting to open the drawer who had not properly operated the combination, would fail to do so, but give an alarm that such an attempt had been made; but for nearly sixty years it does not seem to have suggested a necessity for a cash register to any one's mind.

The third distinct step was covered by U. S. Patent No. 58,490 to Shultz, October 2, 1866, whose machine was very crude. The next was by Henry Pottin, 79 Rue Turbigo, Paris, May 28, 1877, No. 2,076, who was apparently the first to devise means by which the raising of one tablet would throw all formerly raised tablets out of view; but his method required an independent mechanism for each key. The next was an English patent by Twine, No. 3,075, August 12, 1878. The fourth improvement was by Ritty & Birch, patent of June 30, 1883. This required a supplemental lever to assist the swinging tablet holder in its work. Mr. J. J. Webster further simplified and improved this feature by making a complete return of the key necessary before it could be again depressed as patent No. 370,363, September 28, 1887.

The whole number of patents issued in the United States up to January, 1893 (41 years) is 708. In the year 1892 the number of patents issued was 163.

In the first detailed adding cash register the daily record was found by adding perforated numbers representing the value of different keys, and which were also printed on a moving roll of paper. This was first

done in 1883. Since that time a great number of devices for both detailed and total adding have been patented.

Among the inventors who obtained patents in 1892 H. G. O'Neill leads with 11, J. Pleifer 8, E. N. Foote and J. J. Range 7, H. Cook 5, T. Carney 5, C. Carr 4.

The following is a list of the prolific inventors covering a term of 27 years, viz., from 1866 to 1893: Thomas Carney, 18 patents; William G. Latmer, 12; H. G. O'Neill, 11; Hugo Cook, 11; J. J. Webster, 10; W. C. McGill, 9; William H. Clark, 9; J. Pleifer, 9; John F. Pfeffer, 7; F. J. Patterson, 7; John H. Patterson, 7; I. D. Boyer, 7; Caleb B. Hopkins, 6; Homer A. Herr, 6; Thomas Munnell, 6; Carl W. Weiss, 6; E. N. Foote, 5; J. J. Range, 4; Charles T. Brown, 4; J. Ritty, 3; Clinton H. Maltby, 3.

This long list of patents shows that the American inventor is able to respond to any requirements of the business world, and thus lead to the development of large and important industries.

The greatest demand for these machines is in bar-rooms, the next by druggists and the third by general merchants. Each of the above named businesses requires peculiar arrangements. For bar-rooms a machine is required that not only registers the money received, but the pint and quart bottles sold. In the apothecary business a machine is required with departments for the soda fountain, for prescriptions, for cigars and for fancy goods, all combined in one machine. When a mechanic considers the fact that all the working parts of this machine must be manipulated by the depression and return of the key, which throws up a tablet indicating the purchase, revolves the machinery necessary to add the amount registered by that particular key, the unlocking and opening of the cash drawer and the locking up of the machine, so that keys cannot be depressed when the drawer is open, he will readily see that a cash register becomes a complicated machine, and to be of any value to the owner, must be accurate. To fulfill these requirements a long list of patents has been issued, and the best mechanics have been employed in planning the machinery and tools necessary to produce these machines, and great executive ability has been necessary in the management of this complicated manufacture.

The Milling World must bear the responsibility of the following:

"When Music, heavenly maid, was young, to lofty themes she turned her tongue, but now that she is somewhat old and slightly gray, she whoops 'em up with 'Ta-ra-boom de ay'! When Milling, also heavenly maid, was young, to buhrs and mortars straight she clung, but, now that she is somewhat old and has more sense, she's thrown the old stones o'er the fence and put her stake on rolls forever hence! *Hoc fabula docet:* Music, heavenly maid, while growing older, has not grown wiser, while Milling, t'other heavenly maid, in growing older, has surely been in growing sense a great surpriser."

MANUFACTURES.

The Bessemer mill of the Bethlehem Iron Company resumed operations October 23d after an idleness of two months. One thousand men got employment.

The new meter house for the East River Gas Co. will be entirely of iron and brick. The roof trusses will be of iron covered with corrugated iron and glass, and are designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn.

Frank M. Ashley has opened an office as consulting engineer and contractor in Electrical Exchange Building, 136 Liberty street, New York. He will deal in steam and electrical specialties, and will estimate for entire steam and electric plants.

The new "General Catalogue" of Worthington pumping engines, steam pumps, and pumping machinery, Henry R. Worthington, New York, will be found of interest to all who have to do with machinery for handling or measuring water.

Morse Twist Drill and Machine Company, New Bedford, Mass., has issued a new catalogue of twist drills, chucks, reamers, milling cutters, taps, dies and machinist's tools. It is fully illustrated and of interest to manufacturers and mechanics.

The Philadelphia Traction Co. have placed the order for their new power house with The Berlin Iron Bridge Co., of East Berlin, Conn. The side walls will be of brick, and the roof will be of iron. The building is 190 feet in width, and 168 feet in length, divided into boiler room, engine room and dynamo room.

The New York Knife Co., at Walden, N. Y., are building a new fire-proof store house, to be 28 feet in width, and 100 feet in length. The side walls will be of brick, and the roof of iron, designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn., covered with their well-known anti-condensation corrugated iron.

A certificate of organization of the Connecticut Dynamo and Motor Company, of Hartford, Conn., has been filed with the State secretary. The company will carry on the business of electrical and mechanical engineers. The subscribers to the stock are Roscoe W. Ney and Robert E. Dunston, of Hartford, and Donald McDennid, of Middletown, Conn.

The Foster Engineering Company, Newark, N. J., manufacturers of pressure reducing valves, etc., say that in spite of "dull times" they have been kept busy. They have filled some large orders, and have others that will tax their full capacity for some time. They have recently placed some heavy lathes in their works, which are kept busy on their orders.

The P. H. & F. M. Roots Co., Connersville, Ind., write us: The World's Fair authorities have awarded us a medal and diploma on all of our different lines of manufacture which are as follows: Roots' rotary pressure blowers; Roots' rotary force pumps; Roots' rotary gas exhausters; Roots' portable forges; Roots' blacksmith blowers; Roots' combined fire-beds and tuyere irons.

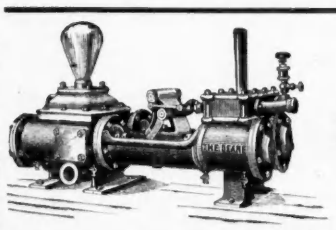
The Lodge & Davis Machine Tool Co., of Cincinnati, O., have booked orders from the following foreign concerns within the past few days; Maschinenbau, Actien, Gesellschaft, Nuremberg, Germany; San Andres Chalchicomula, Puebla, Mexico; Grafenstaden Machine Works, Grafenstaden, Germany. These orders have resulted from a personal inspection of this company's tools at the World's Fair.

The Builders Iron Foundry, Providence, R. I., has issued in pamphlet form as an addition to their catalogue, Mr. Clemens Hershell's paper on the "Venturi Meter." This meter for measuring the flow of fluids is made by this company, upon the principle set forth by Venturi nearly 100 years ago. It consists of two truncated cones joined at their smallest diameters by a short throat piece, and a recorder which registers the quantity of water that passes through the tube. The meter is in form to be easily applied and can be conveniently used in very large sizes when required.

Lintner & Sporborg, of Gloversville, N. Y., have brought out a new revolution counter, which embodies several improvements, among them a pistol grip handle, two worms—a right and left hand, either of which can be engaged with the wheel for shafts running in either direction, ball thrust bearing on worm shaft, a train of reducing gears which indicates revolutions up to 5,000, and a trigger by which the worm-wheel is connected and disconnected from the worm at any instant, the worm shaft running continuously, thus increasing the accuracy of the count. The wheels are set at zero by turning knurled knobs at the back.

The National Water Tube Boiler Company, New Brunswick, N. J., write: The contracts of the several boiler companies with the World's Columbian Exposition required the evaporation of a given amount of water per hour, based on the usual standard of 30 pounds per horse-power per hour. In the official tests made by the Exposition, to determine whether or not the guarantee has been reached, the National Water Tube Boiler Company's plant has shown an average duty of 41 per cent. over the contract. The highest average excess reached by any of the other plants is 19 per cent, while several are below the guaranteed duty, and others only 5 per cent. above. The "National" boilers are nominally rated at 1,500 horse-power, but as rated in the tables of the company are only 1,330 horse-power. The equivalent evaporation for several consecutive weeks, as shown by the official tests, has been that of over 2,000 horse-power, with not the least appearance of forcing. The steam continually furnished is exceptionally dry.

To our friends and patrons: The fire which destroyed the wall paper and furniture factories, coal yard and dwellings, extended to one of our buildings. Our works comprised two five-story brick buildings, each 75 ft by 75 ft., with ample space between and behind them. They were connected by a tunnel and bridges. The east building, Nos. 512-514-516, was considerably damaged. The basement and first floor were used for our shafting department, and the other floors as warerooms and storerooms for finished machines and patterns. The west building, Nos. 520-522-524, is uninjured. Here we have all of our principal machine tools, as well as our drafting room, pattern shop, office, etc. We anticipate little or no trouble in filling orders. Send them right along. We shall be very thankful for them, and we promise to give them our prompt and careful attention. We guarantee the very best mechanical designs and workmanship, and materials of the best quality. Very respectfully, P. Pryibil, 512-524 West 41st street, New York City.



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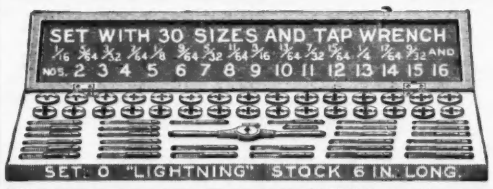

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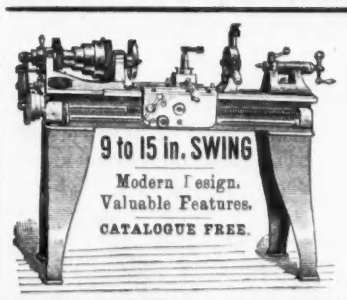
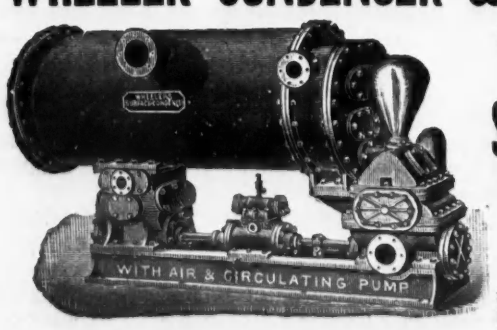
Philadelphia, Pa.



SEBASTIAN LATHE CO.
117 & 119 Culvert St., Cincinnati, O.
Manufacturers of Foot and Power
ENGINE AND SPEED LATHES,
For General Machine and Jobbing Shop, Electrical and Experimental Work.
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

WHEELER CONDENSER & ENGINEERING CO.
39 & 41 Cortlandt St., New York.
MANUFACTURERS OF IMPROVED
SURFACE CONDENSERS.
The Wheeler Admiralty Condenser.
The Wheeler Standard Condenser.
Condensers for Electric Light and Power Stations, Mills, Mines, Ice and Refrigerating Plants. Condensers with and without pumps.



H. W. JOHNS'
ASBESTOS
ASBESTOS SECTIONAL PIPE COVERINGS.
NON-CONDUCTING COVERINGS FOR STEAM AND HOT WATER PIPES, BOILERS, ETC.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y.
JERSEY CITY. CHICAGO. PHILADELPHIA. BOSTON. LONDON

A New Bedford (Mass.) dispatch says: A decided improvement is to be observed in the local industrial outlook, and the output of the manufacturing establishments of the city will show a substantial increase the coming week. The Bennett Mill No. 1, which has been idle for a considerable period, will resume operations, and a portion of Potomska Mill No. 1, which has been shut down for some weeks, will be started up. At the annual meeting of the Tecumseh Mills, of Fall River, the earnings of the year were shown to have been $116,000; surplus, $55,000. A 7½ per cent. dividend was paid. At the annual meeting of the Stafford Mills, the earnings were shown to have been $209,900; dividends, $96,000; surplus, $105,500. At the annual meeting of the Merchants' Mill, the treasurer's report showed an expenditure of $90,000 for new machinery during the year, and balance to profit and loss account of $77,000. Dividends of 9 per cent. were paid. The treasurer's report at the annual meeting of the Union Mills showed earnings of $181,000; expended for new machinery, $52,000. The quick assets are $160,000, and the amount paid in dividends, $90,000.

The Ames Manufacturing Company, Chicopee, Mass., has finished and will ship to Josiah Quincy, of Boston, this week a model of a safety bicycle, which is the first completed machine of that style embodying the ideas of Inventor Victor Berlanger. Whether the claims of Mr. Berlanger as to the speed and general success of the new wheel will be realized, is a matter of much interest to bicyclists. The front wheel and frame work are the same as in the ordinary safety, and it is only the complicated mechanism connected with the rear wheel which will attract the attention of the curious. Mr. Berlanger is confident that the new machine will work wonders, and that our present ideas of speed in bicycles will be changed by it in short order. This company has received the contract from William Reed & Sons, of Boston, for the manufacture of the usual number of New Mail bicycles for the coming season, and work on the wheels began last week. The company has finished five models for the National Cycle Company, of Fitchburg. These machines are chainless, with bevel gears covered with dust-caps, and weigh 35 pounds. When the work of the season has begun in earnest, the number of men on the company's pay-roll, now 213, will be increased to between 600 and 800. The Ames Manufacturing Company is the only concern in the East which makes bicycles to order, and the only other company in the United States which does the same business is the Northwestern Wheel Company, of Chicago.—*Springfield Republican.*

Machinists' Supplies and Iron.

NEW YORK, October 28, 1893.

Iron—American Pig—We quote Standard Northern brands No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12.50 to $13.50 for No. 2, and $11.75 to $12.50 for Gray Forge.

Antimony—The market is quiet and steady. We quote L. X., 9⅞c.; Cookson's, 10c. to 10½c.; Hallett's, 9.60c. to 9.65c., and U. S. French Star, 10c.

Lard Oil—Prime City is quoted at 78c. to 80c.

Copper—The market is dull. Sellers are not free in their offerings of Lake Copper, and quote 9¾c. as the inside price. This does not attract the buyers, whose views are not above 9.40c. Casting Copper is held at 9.15c. to 9.30c.

Lead—The market is firmer, with good consumptive demand. Sellers are reluctant to accept the ruling price of 3.55c for spot. Future delivery is held at 3.65c.

Spelter—The market is easy. Sellers are asking 3.70c to 3.75c., but buyers are inclined to hold off until the first of the year.

Tin—The prices continue to decline. The best bids are 20.60c. for spot, 20.65c. for November, and 20.80c. for December. Some business has been done at 20.60c. for spot, and 20.60c. to 20.62½c. for November.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

First-class draftsman and M. E. wants position. Box 111, AMERICAN MACHINIST.

Wanted—Position as foreman of machine shop, or to build machinery by contract. Address Box 118, AMERICAN MACHINIST.

A foreman patternmaker of ability is open to engage with firm building engines, mining and general mach'y. "Experience," AM. MACHINIST.

A mechanical engineer and salesman with 15 years' practical exp. and first-class references is open to engagement as salesman or superintendent of machine works. Box 119, AM. MACHINIST.

Wanted—Thoroughly competent foreman for established job foundry who can invest $5,000 in the business; foundry equipped with all modern improvements. Address A. P. H., AM. MACHINIST.

Want a pos. in drawing room or mach. shop, where I can obtain prac. exp.; understand mech. drawing, have had some shop practice. Willing to start on small salary. B., AMERICAN MACHINIST.

An A1 all around machinist on marine and heavy engine work, pumping machinery, etc., wants a situation; accustomed to handling help; 6 years' on Pacific Coast; A1 references. Address "Pacific," AMERICAN MACHINIST.

A member of the A. S. M. E., 38, married, desires position as general superintendent or manager of machine works, where executive ability, practical knowledge of the business in all its details, integrity and devotion to the interests of the concern, would be appreciated and suitably rewarded. W. O. W., AMERICAN MACHINIST.

Pos. wanted by comp. mech. eng., graduate of polytechnic school, 14 years' shop and office exp. in gen mach'y, pumps, marine work, boilers, struct'l work in timber and iron. Neat draftsman, well recommended. Address Box 121, AM. MACHINIST.

Wanted—Experienced office man. Applicant must have had extended practical experience, be fully conversant with all details pertaining to production and cost sheets, and the general accounts of a large business, as well as fairly up in mechanical correspondence. Applications must state fully as to experience, age, nationality, salary expected, and references. Will be held as confidential, if desired. "Manufacturer," AM. MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Draftsmen's new comb. triangles, etc.; cir. free; small sample, 10c. D. J. Kelsey, New Haven, Conn.

Drawings made of jigs, fixtures, special tools and devices to work in best possible manner. Address Box 62, Providence, R. I.

For sale one 2"x24' Jones & Lamson flat turret lathe, triple-geared head, new, will sell low. Address Box 116, AMERICAN MACHINIST.

For Sale—Complete pattern shop equipment, a bargain, also three sizes hand elevator patterns. Address "Patternmaker," AMERICAN MACHINIST.

For Sale—One 27"x14 foot bed screw-cutting engine lathe. A splendid tool in first-class condition. C. M. & J. B. Hart, Clarksburg, W. Va.

Wanted—To buy a small machine shop and foundry situated in Middle States. Give description, price, etc. Address Box 122, AM. MACHINIST.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.

3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

REDUCED PRICES OF

LECOUNT'S LIGHT STEEL DOG.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	5/8	$ .35	8	2	$1.10
2	1/2	.35	Small set of 8—5.50		
3	3/4	.50	9	2½	1.40
4	1	.60	10	3	1.50
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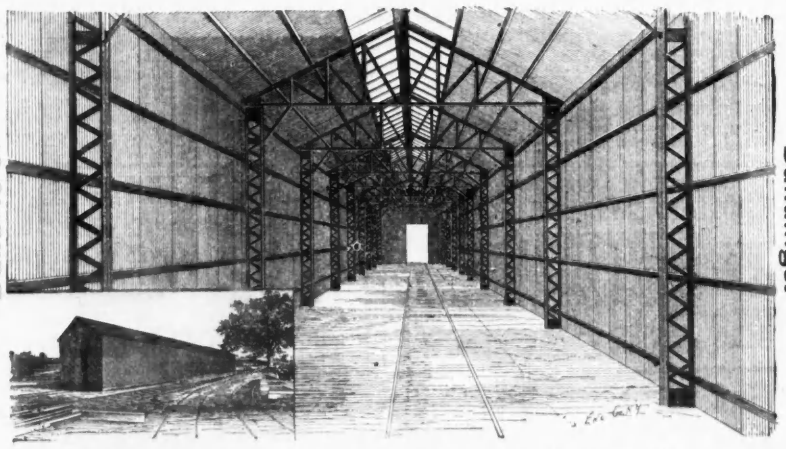
6	1½	.85	12	4	1.90
7	1¾	1.00	Full set of 12—12.00		

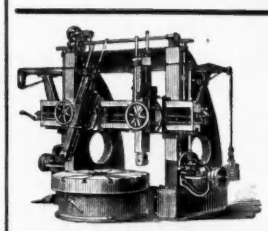
C. W. LeCOUNT, South Norwalk, Conn.
These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

THE BERLIN IRON BRIDGE CO.
Office and Works,
No. 8 Railroad Ave., East Berlin, Conn.
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

Engineers, Architects and Builders of

Iron and Steel Bridges and Buildings.

The above illustration is taken direct from a photograph, and is an interior view in a Store Room designed and built by us for our own use at East Berlin. The construction particularly commends itself on account of the large amount of side wall space applicable for storage purposes, the light being introduced entirely from the roof, no side windows being used, thus allowing all the wall space for storage.

SEND FOR OUR ILLUSTRATED CATALOGUE.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AND OTHER
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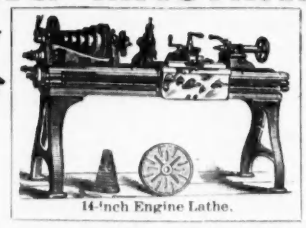
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THE CELEBRATED
ENGINE LATHE
METAL-WORKING MACHINES
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MARK YOUR TOOLS WITH A STEEL STAMP.

SEND FOR PRICE LIST NO. 4.

Improved Lead Fillet for Pattern Makers.

SAMPLES FREE.
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Sole Manufacturer,
44 North 4th St.,
PHILADELPHIA, PA.

IF YOU HAVE ANY SMALL ARTICLES in Brass or Iron that you want manufactured in quantities, write to THE JONES BROS. ELECTRIC Co., 28-30-32 West Court St., Cincinnati, O.

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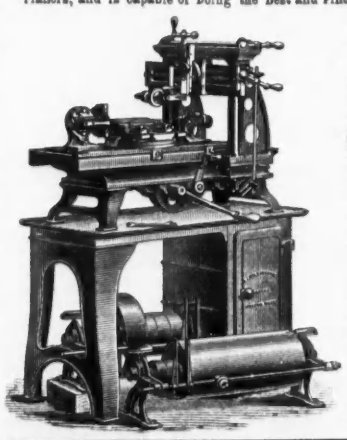
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.

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LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

COOKE & CO.,
163 & 165 WASHINGTON ST.,
NEW YORK.
ENGINES and BOILERS.

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HORIZONTAL,
STATIONARY,
PORTABLE,
Plain and Automatic.
Write for Catalogue and mention this paper.

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Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

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in the pattern room will save its cost EVERY 60 days.

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BE PROGRESSIVE—Get one on Trial.
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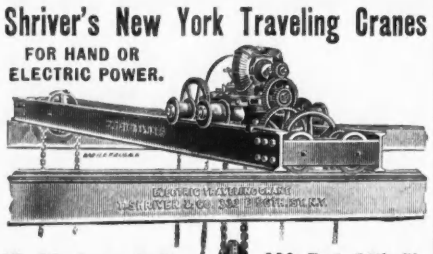
FOR HAND OR ELECTRIC POWER.



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1 Power Elevator, second hand, to li t about 2,500 pounds.
1 Radial Drill about 40" swing.
1 Planer about 40" x 10' bed.
1 Planer about 30" x 6' bed, also 3 lathes one 19", one 30" and one 36".
Good second-hand tools will do.
Address with price and particulars to
"B" BOX 88, NEWARK, N. J.

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Special Low Prices Before Removal.

Engine Lathes, 13, 15, 16, 18, 20 and 24 in.
Planers, 20 x 4 ft., 24 x 8 ft., 30 x 10 ft.
Upright Drills, "Sensitive," 20 and 24 in.
Radial Drill with 5 ft. arm.
Shapers 8, 12 and 15 in. Stroke.
Screw Machine, "Garvin," No. 1 Auto. Chuck.
" " "Brown & Sharpe," No. 1 Wire feed.
" " "Niles," 1⅞ in. hole, Bk. Gears. Carriage feed, Turret feed with cks. and Tools.
Milling Machine, "Lincoln" with Vise.
Vertical Turret Ckg. Mch., 36 in Brown & Sharpe.
Upright Boring and Turning Mill, 38 in.
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Single Punch and Shears, 1 in. hole, 1 in. steel center of 53 in. "Improved Style," weight 11,000 lbs. Used 3 months.
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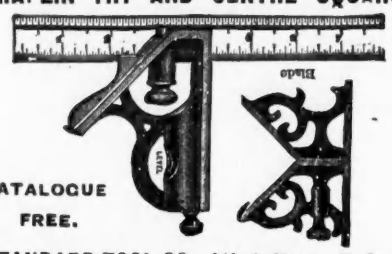

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BARGAINS
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Engine Lathes, from 14" to 48" swing.
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Drill Presses, all sizes up to 24" swing.
Milling Machines, Plain and Universal.
Brown & Sharpe Screw Machines.
1 Large Newton Slotting Machine.
1 Large Pond Mach. Tool Co.'s Radial Drill Press.
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1 Betts Machine Co. large Horizontal Boring Mill.
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1-10 H. P. Baxter Engine, with 15 H. P. Boiler, complete, as good as new.
Also, Tool Grinders, Die Sinkers, Tapping Machines, Bolt Cutters, and large Pattern and Blacksmith Shop Equipments.
These tools are in good order and of the very best makes in this country. They will be sold at remarkably low prices
Call at our salesroom and inspect them, or write for complete descriptive circular and price list.
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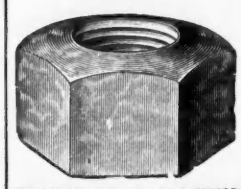

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Boiler Rolls, 8 ft 3 in. between Housings.
Punch, 21 in. Throat, with shear block.
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Hor. Flange Punch, Hilles & Jones, No. 1.
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Boiler Clamp.
Engine Lathes, from 12 in. to 92 in. Swing.
Planers, " 20 " " 62 " Wide.
Drills, " 16 " " 44 " Swing.
Radial Drill, Hilles & Jones, 48 " Arm.
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Builders of WIRE FORMING MACHINES
With F. B. Manville's Patent Sliding Former,
For making articles from the coil, of either round, half-round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.
☞ **Bicycle and Labor Saving Machinery a Specialty.**

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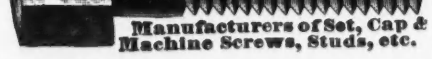
WORCESTER MACHINE SCREW CO



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CORCORAN B'LD'G, WASHINGTON, D. C.

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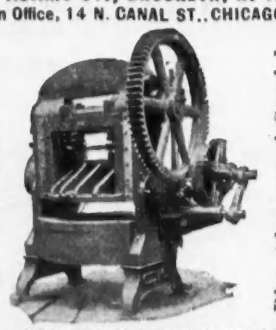

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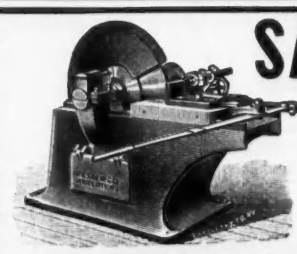

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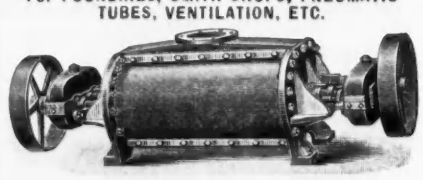

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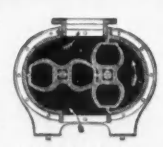

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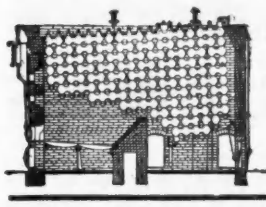

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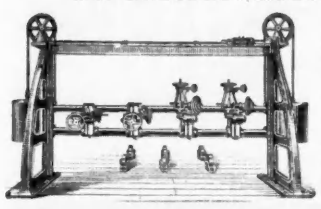

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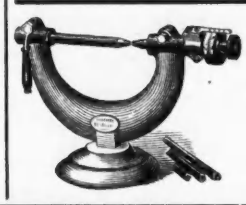

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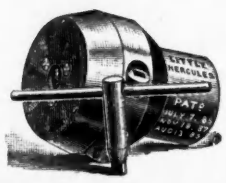

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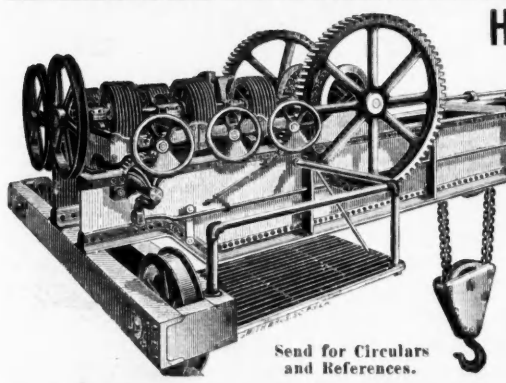

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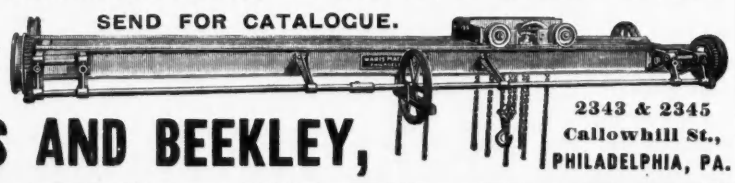

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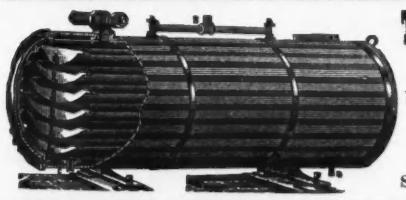

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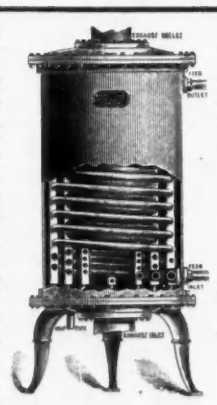

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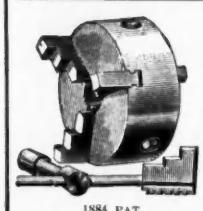
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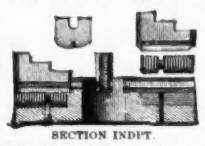
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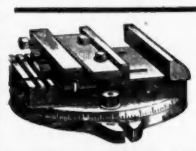

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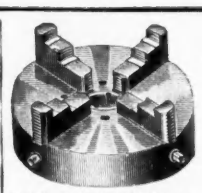
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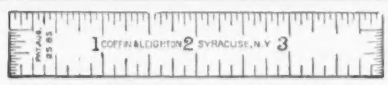

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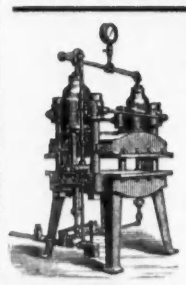
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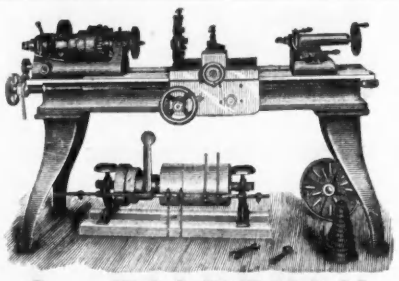

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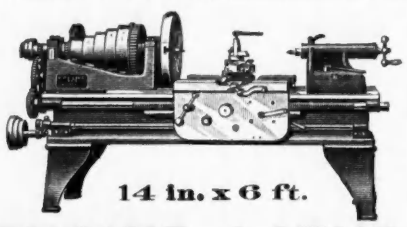

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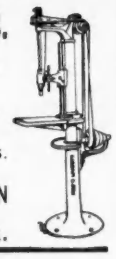

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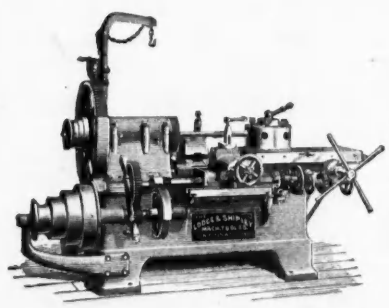

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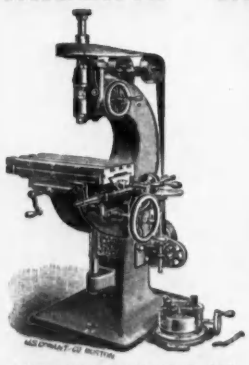

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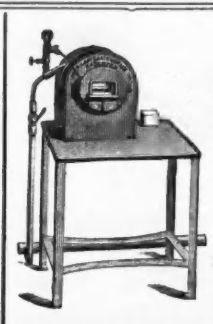

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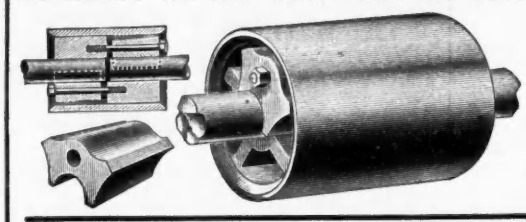

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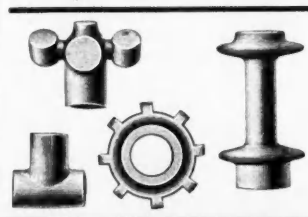

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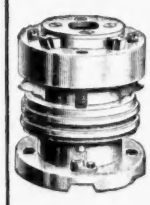

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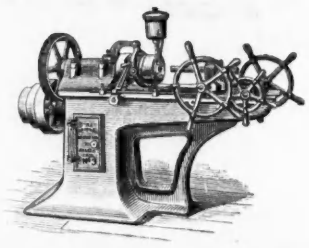

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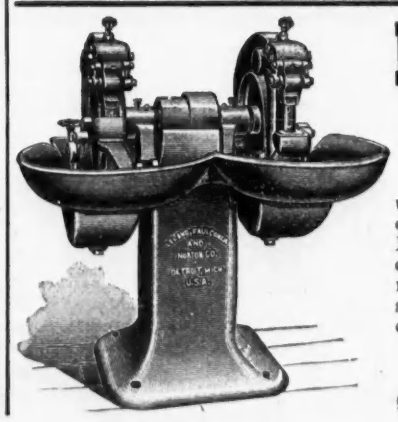

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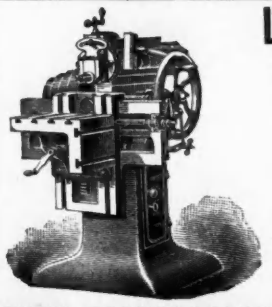

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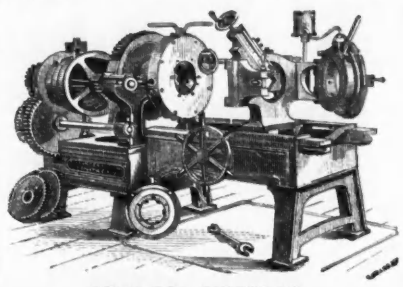

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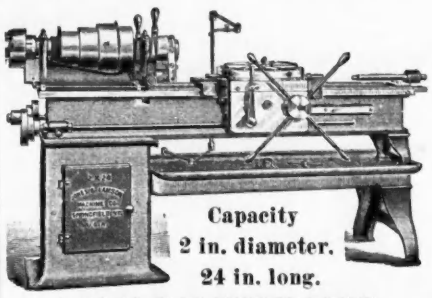

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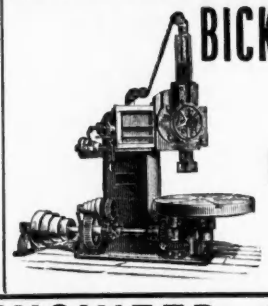

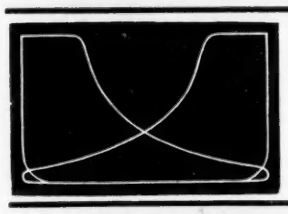

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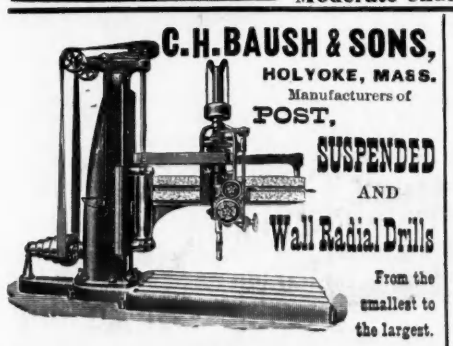

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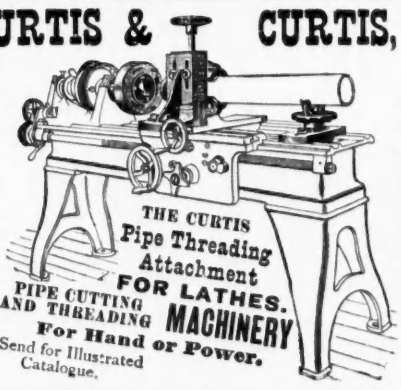

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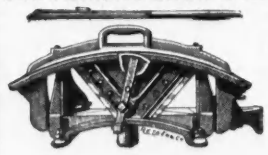

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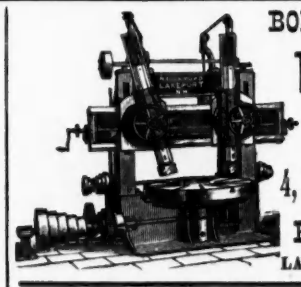

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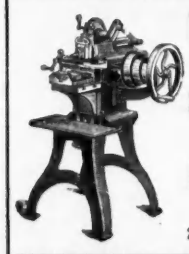

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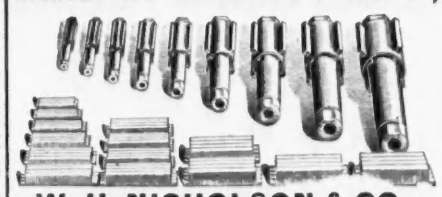

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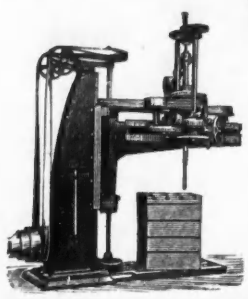

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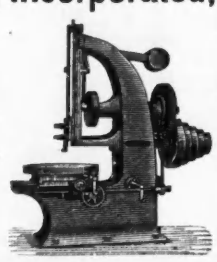

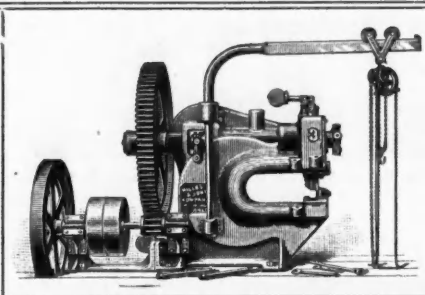

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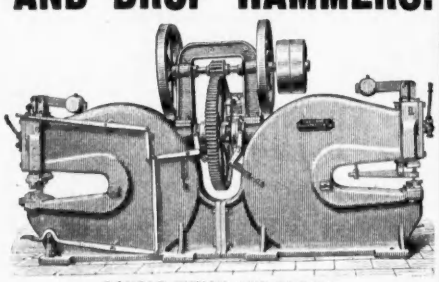

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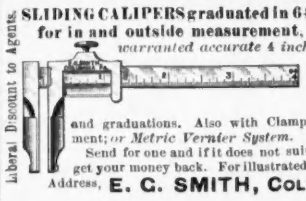

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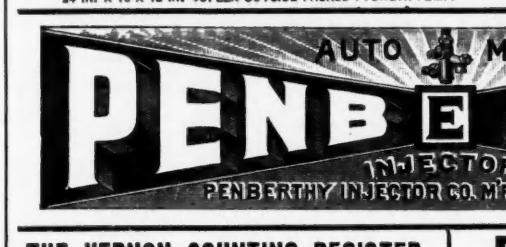

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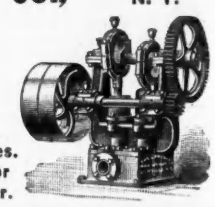

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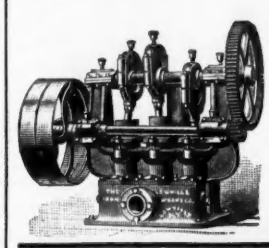

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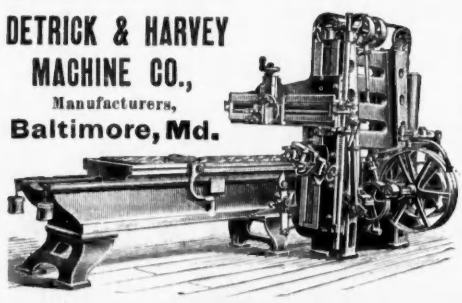

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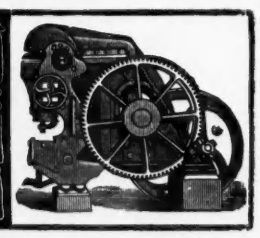

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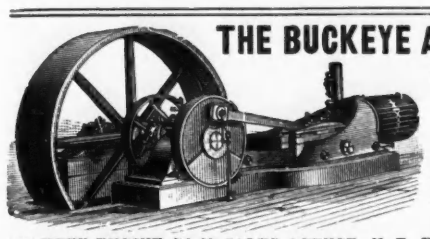

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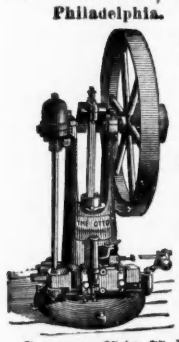

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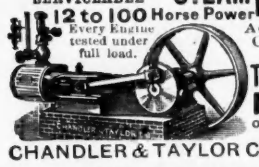

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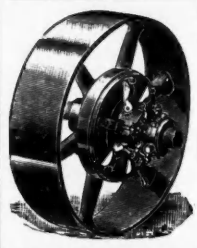

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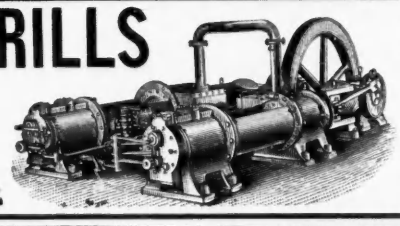

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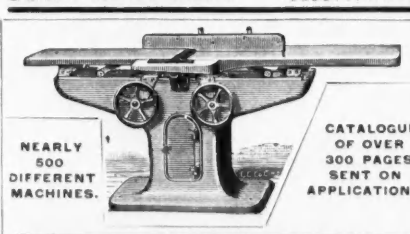

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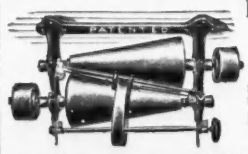

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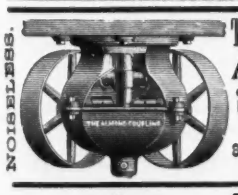

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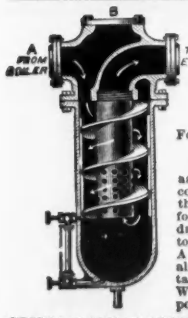

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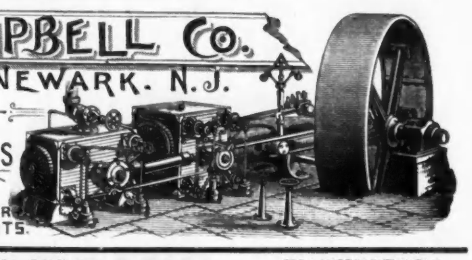

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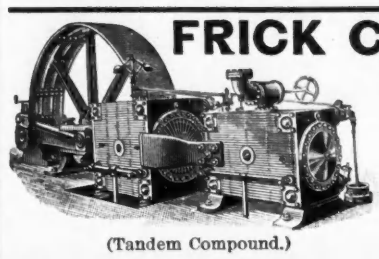

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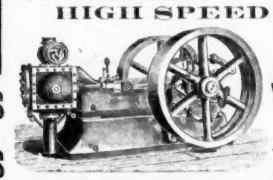

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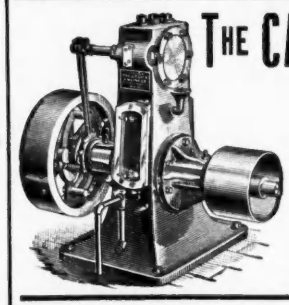

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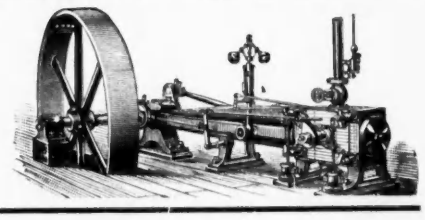

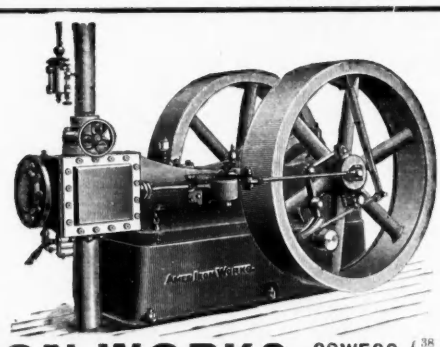

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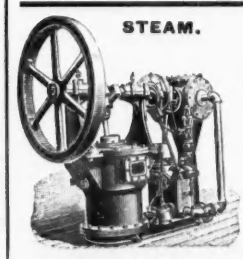

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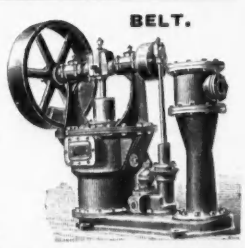

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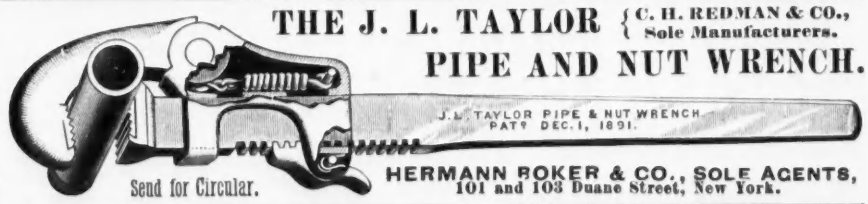

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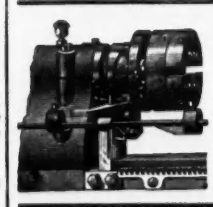

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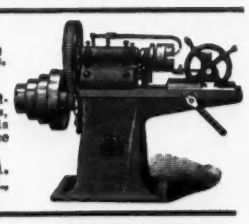

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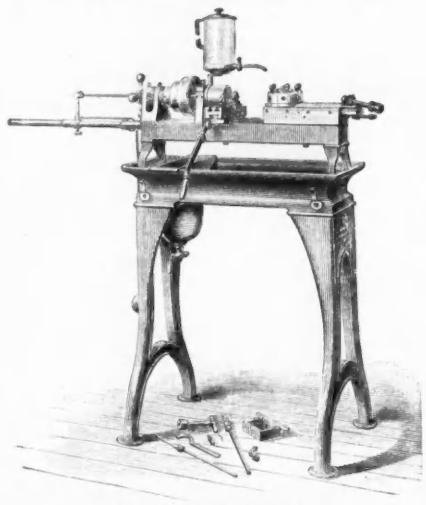

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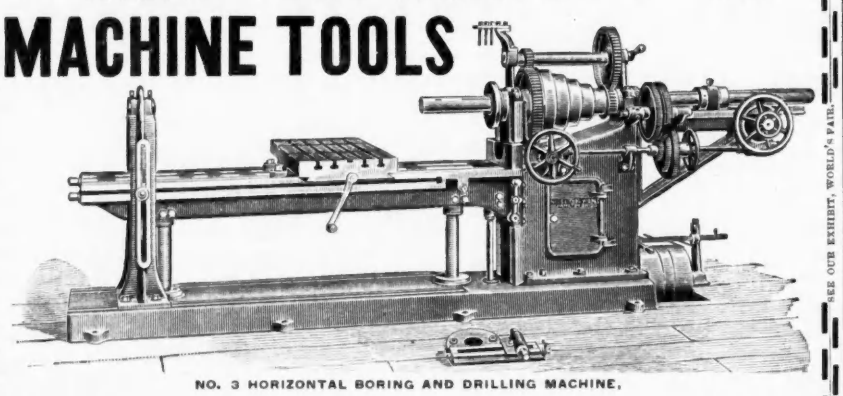

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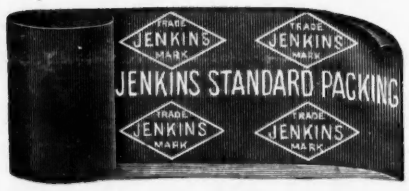

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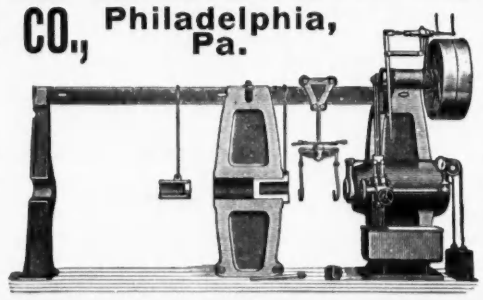

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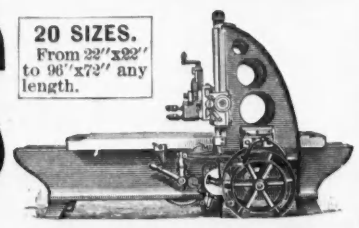

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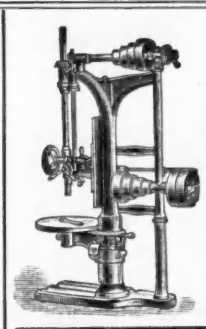

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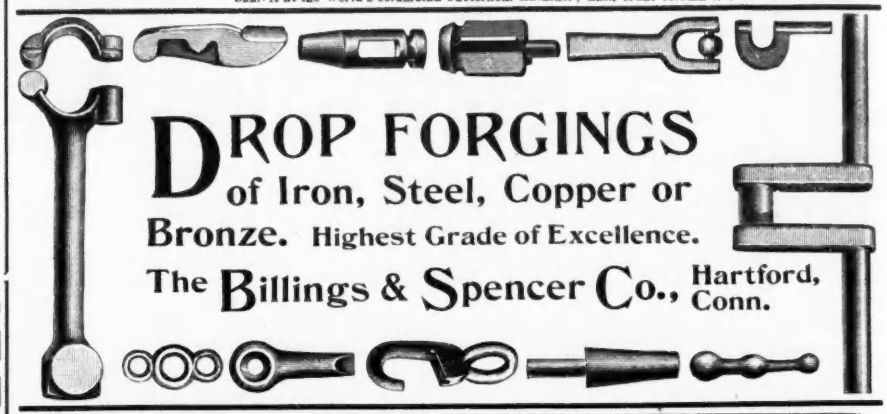

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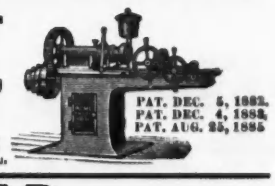

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